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NOTES AND COMMENTS.

The University for London.

SLOWLY, slowly, but still sensibly, the lumbering movement for the institution of a real University for London proceeds. All the great bodies that are interested, even the existing London University, have now intimated their acceptance of the broad principles involved in the scheme of the most recent Commission. The agitation in favour of the existing condition of things is now confined to a flickering, though sometimes brilliant, series of attacks by interested irreconcilables. So long as the great corporations differed on questions of principle, not of detail, action could not be expected from a Government which has to face trouble in all parts of the world, and which has burdened its shoulders with a question of elementary education that will raise the keenest conflict of opinion and prejudice. Now, fearing no one that matters, the Cabinet may place London in a position that is equal, say, to that of St. Andrews or of Jena.

It has been pointed out, by some who are timid and by others who are designing, that the Commission did not arrange that an adult University, equipped with every provision for research and graced by the historic dignity of Oxford and Cambridge, should be born of their labours. It should be unnecessary to say that such a prodigy is to be expected from no Commission. What we want, and what can be given us, is unity in place of distraction, a real University in the place of an examining board. When we have got that, time will add all other things to us. In the present University there is nothing to attract the pious founder and the living benefactor. We believe that the rich men of England are as ready to assist the highest purposes of a University as are the rich men of Australia and America. But there must be a body-corporate, representing by its teachers and professors the best workers in all branches of knowledge, attracting as its students—graduate and undergraduate—the most promising of the youth of our empire.

PROFESSOR MARSHALL WARD ON "MODERN BOTANY."

IN the first lecture of his course on "Some Aspects of Modern Botany" (Royal Institution, February 13), Professor Marshall Ward mentioned that mediæval botany consisted in the collection of native plants, and the attempted identification of these with medicinal and economic plants, described by the ancients, or known from distant countries. Difficulties in identification led to discovery of the fact that different countries had different plants, and thus was laid the foundation of the science of geographical distribution. The careful study of large numbers of specimens led to the evolution of the idea of natural affinities. Efforts at classification were at first vague; men had to learn what parts were comparable. For a time they were like children, distinguishing an oak from a buttercup by the acorn and the flower. Their belief in the existence of sharp lines, which could be brought out if plants were repeatedly and elaborately described, contrasted somewhat with the exaggerated importance which is to-day ascribed to points of resemblance as opposed to points of difference.

Systematists have not yet reached the end of all things. The broader divisions of plant classification may be settled; it may be possible for an expert to indicate, almost at a glance, the exact position of a new species; but the work will not be complete till the list includes all existing and fossil species from all parts of the world. Then the ultimate aim may be achieved, namely, the construction of a genealogical tree showing the true affinities of all known plants. The lecturer went on to emphasise the value of a good Flora, instancing the "Flora of British India," "which, we are all so glad to know, is now nearly complete." It is not merely a list of the plants growing in a certain country, but it tells much about character and localities, range in altitude and distribution in other parts of the world.

The remainder of the lecture was occupied by discussion of some questions of variation and adaptation. First, Professor Ward remarked as to the "purpose" of a hairy covering, of which the Alpine edelweiss supplied an illustration. Consideration showed that this was a concomitant, not of cold, but of dry situations, and was one of several means adopted by the plant for lessening the loss of water by transpiration. The danger of using such adaptive characters for systematic purposes was effectively illustrated by a slide showing a Mexican *Echidnopsis*, a member of the Cactus family, and an African *Euphorbia*, two fleshy-stemmed plants which could scarcely be distinguished except by careful examination. The red colour often assumed by parts of plants other than flowers, especially young leaves, afforded an instance of the danger of pushing an explanation too far. In many instances it doubtless served to absorb some of the sunlight and so protect the chlorophyll of young organs, but such a case as the red colour in the lower layers of the floating leaf of a water-lily demanded

some other explanation. It had been suggested that the light absorbed by the colouring matter might be converted into heat, and that the slight rise of temperature thus effected might perhaps be of importance to the leaf. The genus *Senecio*, of world-wide distribution, and varying from a small herb, like our wayside groundsel, to the tree-like forms occurring on the several mountains of tropical Africa, formed a good subject for the study of the adaptive variations occurring among plants that were shown by the structure of the flowers to be closely allied. Examination of the Indian Senecios threw some light on the meaning of the hairy covering. Of the forty-two species which might be classed as Himalayan, the great majority were glabrous, while those found in the drier climate of the western side of the peninsula were hairy, or showed some form of structure generally associated with dry-growing plants.

The lecturer finished by expressing a strong opinion on the great value of descriptive botany for teaching purposes, and contrasting the present position of students with that in which "the greatest of our living systematic botanists" found himself in his own college days.

The Fertilisation of an Australian Wild-Flower.

In his presidential address to the Philosophical Institute of Canterbury, New Zealand, Professor Dendy, speaking of "Fertilisation of Flowers," refers to a common Australian wild-flower which is somewhat remarkable in this respect. *Stylidium* is the largest genus of a small family, almost exclusively Australian, to which it gives the name Stylidieæ. The species referred to is evidently *Stylidium graminifolium*. The flowers are rather small and are borne on a stem which springs from the midst of a tuft of grass-like leaves. Of the five petals, four spread out in the form of a cross round the tube in which the honey is secreted, while the fifth forms a small lip upon which rests the slender column formed by the union of the stamens and styles, and bearing at the end the anthers and stigma. Near the tip, the column is bent upwards at a sharp angle. The anthers shed their pollen before the stigma is fully developed, the flower thus guarding against self-fertilisation. The bent portion near the tip of the column is sensitive and is the part first touched by an insect, which, visiting the flower in search of honey, pokes its proboscis down the tube. No sooner is this spot touched than the column, which, owing to a sharp bend at its base, is hanging out at one side of the flower, springs over to the other side and brings the anther or stigma down on the back of the insect, thereby attaching pollen to it, or removing some which has been brought from another flower. When the insect has departed, the column resumes its original position and awaits the next visitor, but when the flower has been fertilised it soon loses its power of movement.

This description recalls what may be seen in this country in the

common sage, where a similar result is attained by a different mechanical contrivance. As many of our readers will remember, half of each of the two anthers is barren and forms the short arm of a lever, the other half being borne at the end of the longer arm. In its search for honey the insect butts against the short arm, thereby bringing the long arm down on its back, and carrying off some of the pollen.

THE TEACHING OF MARINE BIOLOGY.

THE greater facilities which have recently been offered to students of biology by the Plymouth Laboratory of the Marine Biological Association, have met with such success that it is proposed to hold a vacation course in marine biology during the Easter vacation, in other words, between March 23 and April 24. The course, which will be conducted by Mr. Walter Garstang, who was formerly a naturalist to the association, will be supplementary to the ordinary laboratory courses of our teaching institutions. Students will be given all the requisite facilities, will be allowed to make collecting excursions on the shore and from the laboratory boats, will have all their material and reagents supplied them, and will have the advantage of daily demonstrations and constant assistance from a practised marine naturalist. The director of the laboratory is fitting up a special room for this purpose, and we are informed that a fair number of students have already intimated their intention of joining. This is hardly to be wondered at, since the fee is not more than that at which a table at this laboratory is let for the purpose of research only, namely, £5 per month. It should be pointed out that this vacation course, which it is hoped will attract numerous students from our universities, is purely voluntary and carried on by private effort. We venture to repeat the hope which we have more than once expressed, namely, that the great universities of our country may come to understand that such a course should be an essential element in the education of every student of zoology, and that they will without much delay institute a similar vacation course upon their own account, and insist on its being attended by all who apply to them for a degree in that subject.

THE ASSOCIATION OF SPECIES.

THE ninth *Annual Report* of the Liverpool Marine Biological Committee, drawn up by Professor W. A. Herdman, has just been sent to us. As is usual with these reports, it is full of a large number of interesting observations. One of the subjects to which the Committee has recently paid special attention is the association of numbers of individuals of different species and genera occurring at various localities on the sea-floor. Several complete lists of different hauls are published, and from them various conclusions are deduced.

In the first place, it is clear that, whether it be a question of mere *mass* of life or of *variety* of life, haul for haul, the shallow waters hold their own against the deep sea, and form, in all probability, the most prolific zone of life on this globe. From the lists which are given it is seen that the species included in each haul belong in each case to a relatively large number of genera. Thus, in one case, the 112 species found were referred to 103 genera, while in a smaller haul thirty-nine species belonged to thirty-four genera, and so on. "These figures," says Professor Herdman, "are particularly interesting in their bearing on the Darwinian principle, that an animal's most potent enemies are its own close allies. Is it then the case, as the above-cited instances suggest, that the species of a genus rarely live together; that if in a haul you get half-a-dozen species of lamelli-branchs, amphipods, or annelids, they will probably belong to as many genera, and if these genera contain other British species these will probably occur in some other locality, perhaps on a different bottom, or at a greater depth? It is obviously necessary to count the total number of genera and species of the groups in the local fauna, as known, and compare these with the numbers obtained in particular hauls. That has been done to some extent with the 'Fauna' of Liverpool Bay." The conclusion thus obtained is that a disproportionately large number is represented by the assemblage of species at any one spot, which means that closely-allied species are, as a rule, not found in association: birds of a feather do *not* flock together. Is it not, however, possible that this fact is a necessary consequence of association or absence of isolation? Allied species of Invertebrata would, if in association, tend to merge into one species through inter-crossing. There are, of course, a few cases of allied species occurring together. Sometimes this may be due to some special habit which, although the species are allied forms, prevents them from being severe competitors. Even sessile animals, such as hydroids and bryozoans, appear to be subject to the same rule, although Professor Herdman suggests that this may act to a less extent in their cases.

In connection with this subject, it would be very interesting if palæontologists would enquire whether the assemblages of fossils found in various deposits, such, for example, as the well-known slabs of the Wenlock Limestone, showed a similar admixture of genera. It is certainly a curious fact that the beautiful slabs from the Wenlock Limestone of Dudley, containing fossil crinoids, which are now exhibited in the Geological Department at the British Museum, contain almost as many genera as species. One slab, for instance, little larger than a man's hand, contains portions of eight crinoid individuals, belonging to eight species and seven genera. Another small slab from the Kinderhook beds of Iowa contains nine individuals, distributed among six species and four genera. This is very different to the crinoid slabs of Secondary age exhibited in the museum galleries, for in their case there is rarely more than one

species of crinoid contained on a single slab. We may infer from this, and from the facts of the distribution of the crinoids of the present day, that the later crinoids were more apt to live together in large assemblages of a single species than were the earlier. The results which this habit has had on their evolution are well-known; one result, for instance, was the extreme length of stem attained by certain species of Liassic *Extracrinus*.

MODERN SHALLOW-WATER DEPOSITS.

WE have previously alluded to the efforts of the Liverpool Marine Biological Committee in investigating the deposits now being formed on the floor of the Irish Sea (vol. vii., p. 229). Further details are given in the *Report* to which we have just referred. We here meet again with Professor Herdman's criticism of Dr. Murray's classification of submarine deposits into terrigenous and pelagic, terms which were fully explained in NATURAL SCIENCE (vol. vii., p. 22 and p. 395; 1895). "In our dredgings in the Irish Sea," says the *Report*, "where the deposits ought all, from their position, to be purely terrigenous, we meet with several distinct varieties of sea-bottom which are not formed mostly from the waste of the land, and do not contain anything like 68 per cent. of silica, but, on the contrary, are formed very largely of the remains of bottom-haunting plants and animals, and may contain as little as 17 per cent. of silica. Such are the nullipore bottoms, and the shell-sand and shell-gravel met with in some places, and the sand formed of comminuted spines and plates of echinoids which we have found off the Calf Island. These deposits are really much more nearly allied in their nature, and in respect of the kind of rock which they would probably form if consolidated, to the calcareous oozes among pelagic deposits, than they are to terrigenous deposits, and yet they are formed on a continental area close to land in shallow water. Moreover, although agreeing with the pelagic deposits in being largely organic in origin, they differ in being derived not from surface organisms, but from plants (the nullipores) and animals which lived on the bottom." Professor Herdman considers, therefore, that the terrigenous group of Murray is an unnatural assemblage, containing many deposits which have very little to do with the waste land. This leads him to propose the following classification:—

1. *Terrigenous* (Murray's term, restricted).—Where the deposit is formed chiefly (say, at least two-thirds, 66 per cent.) of mineral particles derived from the waste of the land.
2. *Neritic*.—Where the deposit is largely of organic origin, its calcareous matter being derived from the shells and other hard parts of the animals and plants living on the bottom.
3. *Planktonic* (Murray's pelagic).—Where the greater part of the deposit is formed of the remains of free-swimming animals and plants which lived in the sea above the deposit.

Another feature of this investigation is, as we have formerly

insisted, the important aid it lends to geologists. Some remarks by Mr. Clement Reid, which are here published, are sufficient evidence of this. "One is again struck," says Mr. Reid, "by the common occurrence of loose angular stones at places and depths apparently well beyond the reach of any bottom drift—at least beyond the reach of currents likely to move such coarse material. This stony sea-bed is in all probability the result of submarine erosion of glacial deposits. Its occurrence renders comparison between recent marine deposits of these latitudes and Tertiary deposits a task of peculiar difficulty; for not only is the nature of the true marine sediments masked, but the fauna also must be greatly altered. It is evident that numerous species which need a firm base on which to affix themselves will be encouraged by a stony bottom; while in a Tertiary deposit, formed under identical conditions, except for the absence of stones, they may be entirely missing, having nothing but dead shells to which to attach themselves. Notwithstanding this peculiarity of most of the dredgings, a few samples may well be compared with our Older Pliocene (Coralline Crag). I would particularly draw attention to certain localities where material almost entirely of organic origin has been obtained. Of these perhaps the most interesting are some samples full of *Cellaria fistulosa* (found to the south-east of the Calf Sound, twenty fathoms). They are in many respects strikingly like certain parts of the Coralline Crag."

The Attachment of Larvæ.

Another line of investigation started by the Liverpool Committee during 1895, is inquiry into the times and modes of attachment of the larvæ of various species, and also as to the most suitable substances for particular kinds of larvæ to settle down upon. This has been carried out by sinking in various parts of the bay an apparatus composed of a rope weighted at one end and buoyed at the other, and having a number of slips of glass, slate, wood, etc., attached at equal distances along its length. These ropes are hauled up and examined periodically. "So far, glass seemed in the early spring (February and March) to be the favourite substance. A surprisingly large number of algæ, compared with the animals, appeared, and nearly all were on the glass slips. Later on, in the summer, barnacles (*Balanus*) made their appearance in great numbers on the slips of wood and on the wooden buoy at the top of the apparatus, while all the upper part of the rope within a few feet of the surface became covered with algæ. A number of ascidians (*Ascidiella virginea*) were also found, in August, to have attached themselves to the rope, and seemed to have got as far as possible in between the strands and into the coils of the knots. On the upper pieces of slate, and, in one instance, on a piece of glass, there were young specimens of the tubicolous Annelid, *Pomatoceros triqueter*, in no case more than a ½ to

¾ inch in length." This inquiry is, of course, not without its practical bearings, and is sure, ultimately, to prove of value to those who desire a more scientific cultivation of the harvest of the sea.

FISH-CULTURE.

THE importance of that scientific intervention with nature in connection with the increase of our marine food-supply, to which we have just alluded, was well brought out by Mr. J. J. Armistead in his recent discourse at the Royal Institution. It was the opinion of Frank Buckland that, in nature, not one egg per thousand produced a mature fish. By fish-culture, on the contrary, 95 per cent. of the eggs laid down are hatched, while of these one-half can, under favourable conditions, be brought to maturity. Roughly speaking, the yield is increased five-hundred-fold. The methods employed must in the first place simulate nature, as, for instance, when the boxes containing pelagic ova are moved up and down so as to produce the effect of wave-motion. Secondly, they must enhance all the favourable conditions, such as the supply of oxygen, the absence of light, the furnishing of sufficiently small and nourishing food; fish get indigestion from artificial foods, and it is to be noted that they travel better on an empty stomach. Thirdly, it is necessary to counteract the numerous adverse influences that are so common in a state of nature, and this applies, not merely to the artificial rearing of fish, but to their preservation generally. No less than thirty diseases are known and diagnosed, and for many of them cures have been found. Accidents of deficiency of water or food in running streams should be guarded against with the help of dams and reservoirs. At the present time our salmon are much neglected in this respect. Whether from lack of food, irregularity of water-supply, differences of specific gravity or temperature, the herring deserted the Firth of Forth some forty years ago and have not yet come back.

The great advance made in this subject during the last thirty years, and the success that meets the attention paid to it by the Governments of Germany and the United States, suggest that we have here a source of national wealth that might well receive more direct care from our own Government.

PRESERVATION OF MARINE MOLLUSCA.

THOSE who were interested in Mr. Hornell's paper on Formalin (NAT. SCI., vol. vii., p. 416), may like to learn that this fluid has been tried for the preservation of *Aplysia* and *Pleurobranchus*. In both cases, however, a considerable amount of colouring matter was dissolved out of the integument. Dr. J. D. F. Gilchrist, who contributes this observation to Professor Herdman's *Report*, also records a method of killing *Aplysia* in an expanded condition, which he says

is the only one that can be depended upon with certainty. "A few drops of a 5 per cent. solution of cocain were mixed with the water in which the Aplysias were. After a time they expanded fully. They were then left in the solution (twelve hours or more) till no contraction took place when removed and put into weak alcohol. If contraction took place, they would be put back into the cocain solution when they again expanded. This was repeated till no contraction took place, when they could, after a time, be put into stronger alcohol."

The Hinge of Bivalve Shells.

The development and morphology of the hinge in bivalve Mollusca is a subject that needs much further elucidation, since it is sure to lead to a better understanding of the inter-relationships of the various members of the class Pelecypoda, and so possibly to a more satisfactory system of classification. A first step in this direction has been taken by Dr. Felix Bernard, of whose valuable work a first instalment appears in the *Bulletin de la Société Géologique de France* (3e ser., tom. xxiii., pp. 104–154). We hope to be able to lay before our readers a full account of Dr. Bernard's researches at some later period when the rest of his paper shall see the light. Meantime, one or two of his results are worthy of special attention. He passes over the embryonic or prodissoconch stage, and taking up his researches from that point, finds, so far as he has gone, that there are two typical forms of embryonic shell. In the second place, he finds that the ligament always arises *internally* in a triangular pit that slants obliquely backwards. Hitherto it has generally been believed that the external ligament was the phylogenetic predecessor. The growth of the ligament affects the curvature of the umbones. He proposes a new notation for the teeth, using odd numbers for those in the right valve and even numbers for those in the left. Dr. Bernard then describes the development of the hinge as shown in a series of stages from the young to the adult individual, and illustrates them with simple but excellent figures. Any conclusions at which he may have arrived concerning the possible connections between the different forms of hinge are reserved for his further communication, when other genera shall have been studied.

Concerning Snails.

Under Mr. Pilsbry's fostering care, the Pulmonata are being brought into better order than they have been for many a long day. He has just (*Nautilus*, February, 1896) established two new "superfamilies," or, as we should say, sub-orders. The one, Aulacopoda, is to include the Zonitidæ, Limacidæ, Endodontidæ, Arionidæ, and Philomycidæ, the characteristic of the group being the presence of grooves that run one on each side the whole length of the foot, a short

distance above and parallel to its edges. These *pedal grooves* rise slightly at the tail and meet above it, the point of their junction being often marked by a local deepening of the groove, the "caudal mucous pore." This last has frequently been used as an important factor in classification, whereas it is merely an occasional extra development.

The Aulacopoda will thus form a group equivalent to the Agnatha (so-called, including the Selenitidæ), or to the group composed of the Helicidæ, Bulimulidæ, Cylindrelidæ, Pupidæ, and Achatinidæ, for which last Pilsbry proposes the name HOLOPODA.

THE NEW PHOTOGRAPHY.

So much has appeared already in the daily and weekly Press that we have little more to do than to call attention to the specimen of the new photography which, by the kindness of Mr. Campbell

PHOTOGRAPH OF THE SKELETON OF A LIVING FROG.

(Taken by A. A. Campbell Swinton, and reproduced from *The New Light*, published for *The Photogram*, by Dawbarn & Ward).

Swinton and the editors of the *Photogram*, we are able to reproduce in these columns. The exact nature of the rays which Professor Roentgen has discovered to be capable of passing through substances that are opaque to ordinary light is still far from certain. It seems as yet to be more probable that they are undulations of some kind, and not, as has been cleverly suggested, a material emanation of small particles. At present, the great difficulty in employing the new process is the absence of a means of focussing the rays. The

actual photographs are no more than the shadows thrown by the substances which are opaque to the rays. To secure clearness of outline, it is therefore necessary that the photographic plate should be very close to the object from which shadows are desired. For instance, it would be very desirable to obtain magnified shadow-pictures of the small bones in the wrist and ancle of many animals, before these had been disturbed by disarticulation. But lenses of all substances that have been employed fail to focus the rays. As usual with a new discovery, the newspapers swallow with avidity a number of extraordinary suggestions and additional applications. It is telegraphed from Rome that one Professor Salvioni, of Perugia, has invented an instrument, the application of which to the eye "enables the vision by means of the Roentgen rays to penetrate opaque bodies. The retina of the eye is impressed by means of this 'cryptoscope' exactly in the same way as a photographic plate." Of course the newspapers may be maligning Professor Salvioni, but it is needless to say that, as the photographs taken by the new method are the result of transmitted—not reflected—light, it would be a wonderful instrument indeed that enabled the eye to penetrate opaque bodies. Professor Edison, too, is well to the fore. Apparently he has abandoned his designs for destroying the British navy by electrified water, and is now turning his attention to photographing the living brain by means of the new rays. In this invention he will have to produce a newer kind of ray. For the living human brain is enclosed in a bony box, and Professor Roentgen's rays have achieved their celebrity by failing to penetrate bone. But the suggestion we like best is that of a French lady, writing to a French journal. She has realised that the new rays penetrate clothing, and she proposes that women should combine against the immorality of modern photography.

Danish and German Science.

We have had on our table for some time three publications with titles that are somewhat formidable to English readers. These are: (1) Forelöbig Meddelelse om Spiraclerne hos Insecterne i Almindelighed og hos Scarabæerne i Særdeleshed m. m. til Paaviisning af hvad dermed tilstrækkelig Dristighed kan udgives for Naturvidenskab. En literair og zoologisk Undersögelse ved William Sörensen, Kjöbenhavn i Juli 1895. (2) I Anledning af Dr. W. Sörensens "Forelöbig Meddelelse om Spiraclerne hos Insecterne" o.s.v. Af J. E. V. Boas, Köbenhavn, 1895. (3) Germanisering af Dansk Videnskab. Ved Dr. H. J. Hansen, Kjöbenhavn, 1895.

These three essays contain the attack, reply, and rejoinder in a sharp personal controversy. The names of the authors are a guarantee that the reader will neither find the subject-matter unimportant nor the handling of it trivial. We do not propose here to enter into the merits of the principal question. They need to be

studied in detail. We shall only make reference to one or two of the incidental discussions which seem especially worthy of attention. The division of the Decapod Crustacea by Dr. Boas into two suborders, the Natantia and the Reptantia, is subjected to a searching analysis by Dr. Hansen, with the result, as it seems, that the proposed division must be regarded as thoroughly untenable. But that against which Dr. Hansen fights most strenuously is, not any particular error or any individual author, but, as the title of his essay implies, against a modern tendency to "germanise" Danish science. While owning the services to science rendered by Germany through her numerous men of genius, he considers that Denmark has a scientific character and spirit of her own distinct from that of Germany. The larger country delights in hypothesis and theory, the smaller in thoroughgoing accuracy of investigation. He rightly considers that it would be a loss to the world to have that national characteristic overborne by the predominating influence of Denmark's powerful neighbour. He views with alarm the introduction of German books of education, German modes of thought, the ambition of the rising generation to study in Germany, to write in German, to win acceptance and commendation in German periodicals. To counteract all this, he is extremely desirous that in the scientific journals of his own country, as an alternative to the vernacular or Latin, the accepted language should be neither German nor French, but only and exclusively English. He urges that English ought to be thoroughly taught in Danish schools, that though not in words, yet in construction, it is far nearer to Danish than is the German language, and that both in England and the English tongue Danish science would find a genial welcome that could not be fraught with any mischievous consequences.

THE GIANT BIRDS.

THE difficulties that beset the study of fossil vertebrates are nowhere better illustrated than in the case of the Dinornithidæ. The remains of these extinct birds have been found in immense numbers, scattered in the superficial deposits of New Zealand. Only in rare instances is it possible to say that any two bones belonged to the same individual, while the number of even moderately complete skeletons is exceedingly small. As names have been founded upon single bones, the greatest confusion has arisen in the nomenclature of the family, owing to there being no means of correlating these bones with one another or with the rest of the skeleton. The difficulties have been further increased by the great individual variation to which these birds were subject, and also by the reconstruction of skeletons from odd bones which may belong to several species.

Several attempts have been made to evolve order out of this chaos, and perhaps the most successful is that of Mr. Lydekker in the British Museum Catalogue of Fossil Birds. The only way,

however, of finally clearing the matter, will be to take some characteristic portion of the skeleton as the standard of reference, even at the risk of displacing some older names that have been applied to other parts. An important advance in this direction is made in a valuable paper by Professor Jeffery Parker "On the Cranial Osteology, Classification, and Phylogeny of the Dinornithidæ" (*Trans. Zool. Soc. London*, vol. xiii., part 2; 1895). In this, detailed descriptions are given of the various types of dinornithine skulls, and an attempt is made to determine the number of genera and species into which the family may be divided, taking this portion of the skeleton as the criterion. The results obtained agree in the main with those of Mr. Lydekker, the only important difference being that some of the species referred by him to *Anomalopteryx* are placed under the genus *Mesopteryx* of Hutton. It would be a great advantage if this nomenclature could be adopted, for this is one of the instances in which a pedantic application of the law of strict priority would only make confusion worse confounded.

In the last part of his paper the author enters into a very interesting discussion on the relations of the genera to one another, and of the Dinornithidæ as a whole to the other Ratite birds, in so far as those relations can be determined from the structure of the skull. He considers *Mesopteryx*, with its lightly-built skull and slender beak, the least specialised form; while he suggests that *Dinornis* and *Emeus* are the most highly modified, the former having probably arisen from the primitive stock independently of the other genera, while the latter is derived from the ancestor of *Mesopteryx*. As to the relations of the family to other Ratites, he considers that its nearest ally is *Apteryx*, and that they are both connected with the primitive stock which also gave rise to the Australian Ratites, the emu and the cassowary. The ostrich and rhea are regarded as having arisen independently from the "Proto-carinatæ." This view harmonises with what might be expected from the geographical distribution of the Ratitæ, and is further supported by many structural differences other than those found in the skull.

The Kea.

In our number for November, 1895, vol. vii., p. 304, we quoted from the *Zoologist* some remarks by Mr. Taylor White anent the Kea of New Zealand. The *Otago Daily Times* for December 14 has criticised both the facts and opinions of Mr. White somewhat severely, and since its editorial note on the subject appears to be written by one speaking with authority and not as the scribes of the daily Press, we think it advisable to show our readers what the New Zealanders themselves think of Mr. White's views. "His facts," says the *Daily Times*, "appear to be the more interesting features. We have Mark Twain's authority for the statement that there is

nothing quite so humorous as facts, and here we have something to support the assertion. We observe *imprimis* that Mr. White does not live in the kea country, but probably 400 miles from it. He quitted the desolate mountains of the South Island many years ago. To judge by the extract before us, the original food of the kea was not berries, but 'lichens on stones,' that it took to tearing these off, and then, mistaking a dead sheep for a lichen on a stone, tasted that and found it beaksome. It lived on the mountains far above the region of berries. Now, there is a well-known idea among shepherds that the strange habit of the kea did arise somewhat in this way, but not from a taste for lichens. There is, in the alpine regions of the South Island, a plant popularly called the 'vegetable sheep,' botanically named *Raoulia*. From the distance of even a few yards it looks like a sheep. It grows in great masses, and consists of a woolly vegetation. A large specimen of this singular plant was exhibited in the Colonial and Indian Exhibition.[1] It is said that the kea was in the habit of tearing it up to get at the grubs which harbour within the mass, and that mistaking dead sheep for vegetable sheep it learned the taste of mutton. A more enterprising generation preferred its mutton rather fresher. Lichens do not come in here. As for the kea living above the region of trees, that is simple nonsense. It is an alpine bird which descends to comparatively low levels at times. It is well known in the region of shrubs about the Mount Cook Hermitage. It is said not to have learned to attack sheep in that district yet—unless during the last few years. We have it on the best authority that when specimens are shot their mouths contain seeds and berries, and we see no reason to doubt that these were once their regular food. The forest level in this province is up to, say, 3,000 feet, but shrubs bearing berries are found much higher, and in Canterbury higher still."

DR. CHARLES JANET ON THE HORNET.

WE have received a number of Dr. Janet's interesting studies on wasps, hornets, and their allies. In one of these, a note on *Vespa crabro* (*Mem. Soc. Zool. de France*, 1895), he gives a detailed account of the construction of the hornet's nest, with many notes on the habits of the insect. It seems that hornets do great damage to trees by nibbling the young shoots, so as to get their juices. Dr. Janet gives an ingenious explanation of the peculiar folding of hornets' anterior wings. The hind margin of the fore-wing, he says, becomes engaged in the front margin of the hind-wing, and is compelled to fold longitudinally, since otherwise it would force the hind-wing over the dorsal surface of the abdomen, as, indeed, occasionally happens in young individuals. If the wings came to lie dorsal to the abdomen, they would become frayed and torn in the narrow passages of the

[1] And may now be seen at the Natural History Museum.—Ed. NAT. SCI.

nest. The dorsal surface of the abdomen itself not infrequently shows signs of rubbing. We doubt, however, if this explanation is of universal application, for in solitary wasps the fore-wing is similarly folded, although these build, not nests, but mud-cells, in which there is plenty of room to turn about.

The Archæology of Yucatan.

The arid peninsula which lies between the Gulf of Honduras and the Gulf of Mexico has recently afforded a rich harvest to the archæologist. The numerous ruined cities of the Mayas have been described, first, in *Globus* for October last, by Theobert Maler, and, secondly, in an essay by Professor W. H. Holmes, of the Columbian Museum, Chicago. A map of Yucatan and Tabasco appears in the atlas to A. P. Maudslay's fifth contribution to the "Biologia Centrali-Americana," together with numerous views of buildings and architectural details. More within our scope, however, is the well-illustrated volume on the Hill-Caves of Yucatan recently published for Henry C. Mercer by Lippincott & Co., of Philadelphia. This records a praiseworthy attempt to establish the relative antiquity of man in Yucatan by means of a systematic investigation of the caverns in the Sierra. The exploration was originally suggested by Professor Heilprin, who had noticed the existence of a series of caves hitherto undescribed, containing aboriginal carvings on their walls and showing signs of human habitation. The expedition was financed by John White Corwith, of Chicago, and its members spent two months of last year in the country, mostly underground, visiting twenty-nine caves. All these occurred within an area of 100 miles in length by ten in breadth. Ten caves were excavated, of which six yielded valuable, and three decisive, results, chiefly of a negative character. "We had found no copper, gold, or silver, no jade, no gums, no preserved grains, no apparatus for weaving, and had discovered no pipe and learned nothing of pre-Columbian smoking or tobacco." The animal remains found belonged either to recent or late Pleistocene species, and were determined by Professor Cope. None were extinct. The shells examined by Mr. Pilsbry yielded like results. "Pottery grew rarer, or disappeared altogether towards the bottom of the ash films, yet there was no evolution in the ware. We found no Palæolithic man, no *Homo neanderthalensis*, no *Pithecanthropus erectus*, but a builder of cities inferably the superior of most North American tribes when he appeared upon the scene." The primitive immigrants must have visited the hill-caves for water; they were but temporarily occupied by a race of agriculturists rather than hunters. Some practised cannibalism, possibly a ritual form. Split human marrow-bones were found at Coyok, Loltun, and Actun Sabaka.

All the evidence obtained from a series of trench-diggings down to bedrock in various caves, revealing ashes, bones, and potsherds,

was purely of a negative character, and led Mr. Mercer to conclude, like that prince among pioneers, Stephens, "that no earlier inhabitant had preceded the builders of the ruined cities of Yucatan. That the people revealed in the caves had reached the country in geologically recent times. That these people, substantially the ancestors of the present Maya Indians, had not developed their culture in Yucatan, but had brought it with them from somewhere else."

Therefore, despite the energy of Mr. Mercer and his colleagues, this straightforward and detailed account of their investigations leaves unanswered the burning question of American archæology: Whence came the Aztecs and Mayas?

The Bohemian Museum.

We have very great pleasure in publishing in this number the interesting description, with which Professor Anton Fritsch has favoured us, of the arrangement that has been introduced in the New Museum of Natural History at Prague. We, who have always been advocates of the intelligent method of museum exposition, are especially pleased to see that the important and classical collections contained in this museum have been arranged on such a truly scientific plan. All who have engaged themselves in practical museum-work know well enough how difficult it is to combine the two very different aims of general instruction on the one hand, and the illustration of the natural history of a limited district on the other. In a metropolitan museum, such as that at Prague, it is, of course, necessary to pay considerable attention to the large general public that supports the museum. But when we consider the extreme scientific interest of the collections, notably those that illustrate the great "Système silurien" of Barrande, we must admit that a far larger number of specimens ought to be exhibited than such a one as, say, Sir Henry Howorth would consider absolutely necessary. But, by the juxtaposition of drawings and references to literature along with the specimens, as represented in Fig. 1 (p. 169), the systematic collections themselves subserve the purpose of more general instruction. Those who have recently visited the Bohemian Museum can substantiate the claim of Dr. Fritsch that the problems to which we have alluded are adequately solved.

925.7

I.

Professor Huxley: from the Point of View of a Disciple.

AMONG the various estimates of Mr. Huxley's life and work that will have appeared before the present article can possibly see the light, I venture to hope that there is still room for a brief account of him as he appears to a disciple. For the pupil and assistant of a great teacher has, within a certain limited field, the best possible opportunities of judging of his master's work and character, especially when, as in the present instance, a considerable lapse of time has served to furnish something like the due perspective.

To the general public who think of Huxley chiefly as a merciless iconoclast, a keen controversialist, an incomparable popular exponent of science, the fact that he contributed certain papers to learned societies, wrote such and such text-books, and for thirty years lectured on the elements of Biology to a handful of students at the Royal School of Mines, are matters of little interest or moment. Nevertheless, it is obviously upon his technical and non-popular writings and upon the character of his teaching that his reputation as a man of science must stand or fall.

Judged by his original contributions to science, there can be no doubt that Huxley's performance falls far short of his capabilities, and that there is hardly a man of first-class ability among his contemporaries who has not produced more. Leuckart, Koelliker, Haeckel, Gegenbaur, are the names one naturally connects with his, and it must be frankly conceded that there is not one among them who has not left a deeper mark upon Zoology than he, or whose works are not more frequently referred to by the professional zoologist. Three of his researches may fairly be called classical: that on the Hydrozoa, in which he propounded the wide-reaching generalisation that the ectoderm and endoderm of polypes and sea-anemones correspond with the two primary germ-layers in the embryos of the higher animals; that on the fossil Ganoids; and that on the morphology of the vertebrate skull, in which he demolished the fanciful "vertebral theory," which, however fruitful in its first conception, had become a positive hindrance to the progress of philosophical anatomy. Of less magnitude are his papers on the classification of birds, on the crayfishes, on the anatomy of the Australian mud-fish, and on the Canidæ,

while the rest of his strictly original contributions to zoology are, for a man of his intellectual calibre, hardly more than opuscula.

But what opuscula! There is not one of them but contains some brilliant generalisation, some new and fruitful way of looking at the facts of the science. The keenest morphological insight and inductive power are everywhere apparent; but the imagination is always kept well in hand, and there are none of those airy speculations—a liberal pound of theory to a bare ounce of fact—by which so many reputations have been made. As examples of scientific method, his papers are always valuable, and none more so than the Croonian Lecture on the theory of the vertebrate skull. I admit that vertebrate morphology has advanced so much since 1858 that it requires almost an antiquarian taste to go back so far, but the modest little pamphlet is still capable of furnishing some excellent lessons even to the youngest and most infallible of modern morphologists.

Looking at the matter from rather a narrow and professional standpoint, I am inclined to think that modern biology owes a larger debt to Huxley the teacher than to Huxley the investigator. His lectures were like his writings, luminously clear, without the faintest disposition to descend to the level of his audience; eloquent, but with no trace of the empty rhetoric which so often does duty for that quality; full of a high seriousness, but with no suspicion of pedantry; lightened by occasional epigrams or flashes of caustic humour, but with none of the small jocularity in which it is such a temptation to a lecturer to indulge. As one listened to him one felt that comparative anatomy was indeed worthy of the devotion of a life, and that to solve a morphological problem was as fine a thing as to win a battle. He was an admirable draughtsman, and his blackboard illustrations were always a great feature of his lectures, especially when, to show the relations of two animal types, he would, by a few rapid strokes and smudges, evolve the one into the other before our eyes. He seemed to have a real affection for certain of the specimens illustrating his lectures, and would handle them in a peculiarly loving manner; when he was lecturing on man, for instance, he would sometimes throw his arm over the shoulder of the skeleton beside him and take its hand, as if its silent companionship were an inspiration. To me the lectures before his small class at Jermyn Street or South Kensington, with the skeletons and "pickles" on the table before him, were almost more impressive than the discourses at the Royal Institution, where for an hour and a half he poured forth a stream of dignified, earnest, sincere words in perfect literary form, and without the assistance of a note.

Occasionally, but very rarely, his iconoclastic tendencies peeped out in his lectures. On one occasion he was describing the heart, and came in due course to the mitral valve. "This valve," he said, "is so called from a supposed resemblance to a bishop's mitre. You know the thing I mean—a sort of cross between a fool's cap and a

crown." The same subject served for another epigram. At a meeting of examiners we were talking of the difficulty students experienced in remembering whether the mitral valve was on the left side or the right. Huxley told us that when he was a student he always remembered by saying to himself "a bishop's never in the right."

In the promotion of the practical teaching of biology, Huxley's services can hardly be over-estimated. Botanists had always been in the habit of distributing flowers to their students, which they could dissect or not as they chose; animal histology was taught in many colleges under the name of practical physiology; and at Oxford an excellent system of zoological work had been established by the late Professor Rolleston. But the biological laboratory, as it is now understood, may be said to date from about 1870, when Huxley, with the co-operation of Professors Foster, Rutherford, Lankester, Martin, and others, held short summer classes for science teachers at South Kensington, the daily work consisting of an hour's lecture followed by four hours' laboratory work in which the students verified for themselves facts which they had hitherto heard about and taught to their unfortunate pupils from books alone. The naïve astonishment and delight of the more intelligent among them was sometimes almost pathetic. One clergyman, who had for years conducted classes in physiology under the Science and Art Department, was shown a drop of his own blood under the microscope. "Dear me!" he exclaimed; "it's just like the picture in Huxley's 'Physiology.'"

In 1872, when the biological department of the Royal School of Mines was transferred to South Kensington, the same method was adopted as part of the regular curriculum of the school, and from that time the "teaching" of zoology by lectures alone became an anachronism.

The system of practical teaching thus inaugurated has not always been happy in its continuators, and the excellent manual in which it is partly embodied—Huxley and Martin's "Practical Biology"—has had something to do with certain misconceptions as to its nature. Huxley's method of teaching was based upon the personal examination by the student of certain "types" of animals and plants selected with a view of illustrating the various groups. But, in his lectures, these types were not treated as the isolated things they necessarily appear in a laboratory manual or an examination syllabus; each, on the contrary, took its proper place as an example of a particular grade of structure, and no student of ordinary intelligence could fail to see that the types were valuable, not for themselves, but simply as marking, so to speak, the chapters of a connected narrative. Moreover, in addition to the types, a good deal of work of a more general character was done. Thus, while we owe to Huxley more than to anyone else the modern system of teaching biology, he is by no means responsible for the somewhat arid and mechanical aspect it has assumed in certain quarters.

Considering Huxley's unrivalled capacity as a teacher, it is a remarkable fact that he never founded a school. His influence on contemporary zoology and zoologists was, as it could hardly fail to be, profound, but it was exercised mainly by his writings and by the magnetism of his strong individuality. His actual teaching was all elementary, and there never issued from his laboratory that perpetual succession of young investigators which makes the distinction of the great German universities, and which, in England, we associate especially with the names of Michael Foster, F. M. Balfour, and Ray Lankester. In the teaching of his regular class Huxley spared no pains and gave of his best, but when his duties were over he was too much engrossed in his own investigations to care about being worried with the difficulties and triumphs of the embryo researcher. I once went to him with a question about the codfish's brain at a time when he was working at some invertebrate group. "The cod's a vertebrate animal, isn't it?" he asked; "well, I don't know anything at all about vertebrate animals." This answer was quite characteristic; his immersion in the work in which he was actually engaged was so strong as to produce a complete want of interest—at least, during working hours—in anything else, and resulted in the fact that nearly all the students who began the study of zoology under him went elsewhere as soon as they began to feel their feet.

The unbounded pains he took with his lectures were nowhere better displayed than in the courses for working-men at Jermyn Street. A course of half-a-dozen lectures would take months of preparation: he neglected no point, however insignificant, slurred over no difficulty, however apparently unimportant, and gave as much thought and research to an audience of clerks and mechanics as he would have given to one composed of the most distinguished men of science. His books, "Man's Place in Nature" and "The Crayfish," are both founded on courses of this sort, and serve to give some idea of his notions of popular lecturing. And he certainly had his reward, and proved conclusively that a thoroughly popular lecturer is not necessarily the phrase-making *poseur* with whom we are all familiar. Although he never hesitated to use technical language, nor spared anatomical details when necessary, he was listened to, night after night, by an audience having no previous knowledge of the subject, with an attention that never flagged.

In connection with his position as a teacher, some reference must be made to his text-books. The "Lessons in Elementary Physiology," "Introductory Primer," and "Physiography," are so well known and so widely used that it is unnecessary to do more than allude to them as models of scientific method and lucid exposition. But "The Elements of Comparative Anatomy," "The Anatomy of Vertebrated Animals," and "The Anatomy of Invertebrated Animals," appeal only to the student and the teacher of zoology. The "Elements" really consists of two books in one. The first part, on the classifica-

tion of animals, is, perhaps, the most brilliant sketch of animal morphology ever written: it was published more than thirty years ago, and is now, of course, quite out of date, but there is still much refreshment to be had from its perusal, especially in the enjoyment of the novel sensation of finding a writer of scientific text-books with a style. The second part, on the vertebrate skull, is equally striking as a detailed exposition of a limited, but complex, problem: some parts of it are as readable as his popular essays, and in the rest anatomy was surely never made so interesting.

The "Vertebrated Animals," though published nearly five-and-twenty years ago, still remains, so far as conception and mode of treatment are concerned, the best elementary work on the subject. It is clearly and logically arranged, and, while keeping the generalisations of the subject always in view, never fails to give that attention to the details of anatomy without which any statement of principles and theories is absolutely valueless to the student. The "Invertebrated Animals" is a far less satisfactory book; it is uneven and in many ways ill-arranged, and enjoys the distinction of being one of the worst illustrated books of its kind. But all its faults are redeemed by the masterly introductory chapter—one of the sanest, most luminous, and most philosophical essays ever written on the general principles of biology.

As professor, Huxley's rule was characterised by what is undoubtedly the best policy for the head of a department. To a new subordinate "The General," as he was always called, was rather stern and exacting, but when once he was convinced that his man was to be trusted he practically let him take his own course; never interfered in matters of detail, accepted suggestions with the greatest courtesy and good humour, and was always ready with a kindly or humorous word of encouragement in times of difficulty. I was once grumbling to him about how hard it was to carry on the work of the laboratory through a long series of November fogs, "when neither sun nor stars in many days appeared." "Never mind, Parker," he said, instantly capping my quotation; "cast four anchors out of the stern and wish for day."

To many people Huxley appeared hard and unsympathetic, but never to those who saw beneath the surface. Like most men of strong individuality, there were certain kinds of people who excited his strongest prejudices, and when he thoroughly disliked anyone he took no pains to hide his feelings. He once said to my father: "You're a Christian, I'm a pagan; you say 'love your enemies'; I say 'love your friends and hate your enemies,' *and I do hate them.*" To parody a well-known saying—"he hated a bore, he hated a prig, and he hated a parson: he was a very good hater." Naturally, therefore, in his utterances about people and opinions he disliked, he sometimes showed, like Luther, a certain "göttliche Brutalität"; but the half humorous way in which he usually delivered himself of his denunciations

took away all their sting. I was once saying what an edifying sight it must have been to see him showing Cardinal Manning round the rooms a tone of the Royal Society's conversazioni. "Oh! yes," he said; "the Archbishop and I are great friends; he'd burn me if he could, and I'm sure I'd knock all his fraternity on the head." But the twinkle in the deep-set grey eyes deprived this truly mediæval speech of all actuality.

Indeed, no one who came much into contact with him could fail to see that beneath all his prejudices and all his pugnacity was concealed—and not very deeply concealed either—a singularly tender and lovable nature. One of my earliest recollections of him is in connection with a letter he wrote to my father on the occasion of the death, in infancy, of one of my brothers. "Why," he wrote, "did you not tell us before that the child was named after me, that we might have made his short life happier by a toy or two?" I never saw a man more crushed than he was during the dangerous illness of one of his daughters, and he told me that, having then to make an after-dinner speech, he broke down for the first time in his life, and for one painful moment forgot where he was and what he had to say. I can truly say that I never knew a man whose way of speaking of his family or whose manner in his own home was fuller of a noble, loving, and withal playful courtesy.

It has been remarked that great fighters, when they retire from active life, usually take to gardening, and this was true of the most brilliant of Darwin's lieutenants, who "sharpened his beak and claws" to such excellent effect in the great fight which followed the publication of the "Origin of Species." He wrote to me not very long ago, "I begin to think with Candide that 'cultivons notre jardin' comprises the whole duty of man." No one—at least no man of science—could help regretting that he retired from active scientific work so early, and he evidently had something of the same feeling himself. In the letter from which I have just quoted he says: "Looking back from the aged point of view, the life which cost so much wear and tear in the living seems to have effected very little." But the explanation is not far to seek. Apart from ill-health ("some years of continued ill-health . . . have driven me quite out of touch with science, and, indeed, except for a certain toughness of constitution, I should have been driven out of touch with terrestrial things altogether"), he was a man of such wide interests that he could never reasonably have been expected to be wholly devoted to natural science. Religion, politics, psychology, social problems, all that men think of deeply and strive for earnestly, were profoundly interesting to him, and it is hardly to be wondered at that, when he retired from professional work, these things were more to him than the phylogeny of the Mollusca or the last new notochord. Moreover, it must be remembered that he was not, like Darwin, a born naturalist, but a man of all-round capacity, who drifted into biological work by the mere force of circumstances. If

those circumstances had been different he might now be remembered as one of the greatest of engineers, surgeons, or politicians, or he might have died Chief Justice of England or Archbishop of Westminster—one can hardly conceive of his taking the *via media* which leads to Canterbury.

Whether a professor is usually a hero to his demonstrator I cannot say; I only know that, looking back across an interval of many years and a distance of half the circumference of the globe, I have never ceased to be impressed with the manliness and sincerity of his character, his complete honesty of purpose, his high moral standard, his scorn of everything mean or shifty, his firm determination to speak what he held to be truth at whatever cost of popularity. And for these things "I loved the man, and do honour to his memory, on this side idolatry, as much as any."

T. Jeffery Parker.

Otago University, Dunedin, N.Z.

II.

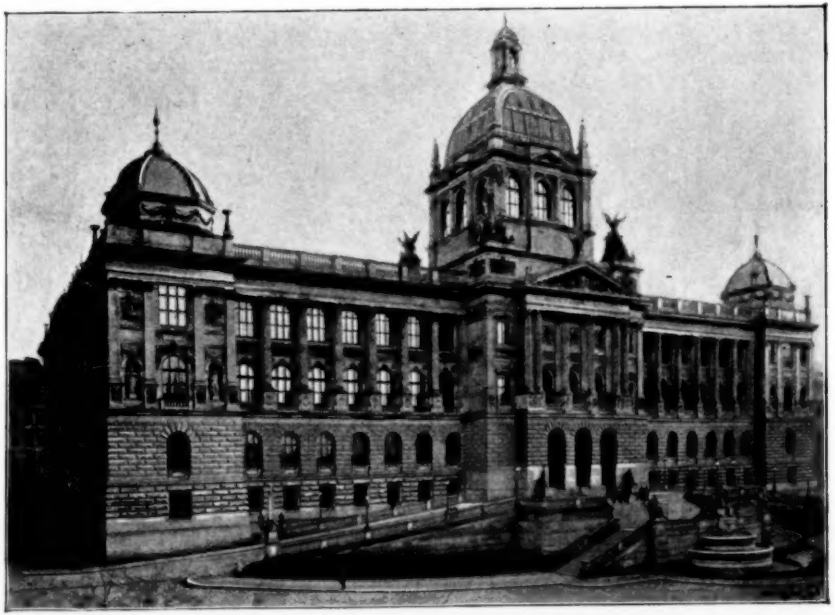
The Natural History Departments of the Bohemian Museum.

TWO years ago the Museum of Natural History at Prague, Bohemia, was transferred to a magnificent building standing in a commanding situation at the top of an ascending street more than a kilometre in length (Plate V.). The first floor of the new building contains the historical, archæological, numismatic, and ethnographical collections, as well as the mineralogical and botanical departments; the second floor, the palæontological and zoological collections.

The chief idea in arranging the collections has been to give prominence to everything characteristic of Bohemia. The foreign collections comprise only such types as are of general scientific interest.

In accordance with this plan, the Bohemian minerals are arranged in the order of their geological age in two large rooms, while the general collection of minerals occupies only one room twenty-six metres in length.

The first room of the geological collection is the Barrandeum, devoted to the collection of the late Joachim Barrande, described in his classic work, the figured specimens being arranged in the transverse cases. The wall-cases contain a collection of azoic rocks, forming the base of Barrande's "Silurian" formation, and consisting of typical specimens collected by Professor Zippe. The fossils from the "Lower Silurian" of Barrande are already arranged and provided with printed labels; while those from the "Upper Silurian" are only partly arranged, because the corals, crinoids, and gastropods are still in the hands of monographers (Professor Waagen and Dr. Počta). The more minute specimens are explained by means of the figures of Barrande's plates, for which purpose the Barrande family has kindly furnished a copy of the entire work (Fig. 1). A special case, devoted to the memory of Barrande, contains the volumes of his monumental work, presented for the purpose of exhibition in the Barrandeum by the executrix, Mdlle. Alène Girardeau. The work consists of 24 volumes and 1,237 plates, and contains the description and figures of 4,630 species, distributed as follows:—



THE NEW BUILDING OF THE BOHEMIAN MUSEUM AT PRAGUE.

UNIV. OF MICH.

AMERICAN MUSEUM
OF NATURAL HISTORY
NEW YORK

Pisces	6	Trilobita, and other Crustacea	447
Cephalopoda	1,127	Bryozoa	88
Gastropoda	600	Echinoderma	80
Acephala	1,269	Species undetermined, about	300
Brachiopoda	640		
Pteropoda...	73		

Beneath a portrait of Barrande, representing him at forty years of age, are exhibited his hammers and other tools, together with photographs of the memorial plate on the rocks at Kuchelbad, and of the house in which he lived and where he kept his collection.

The second room is the Sternbergeum, beautifully arranged, in

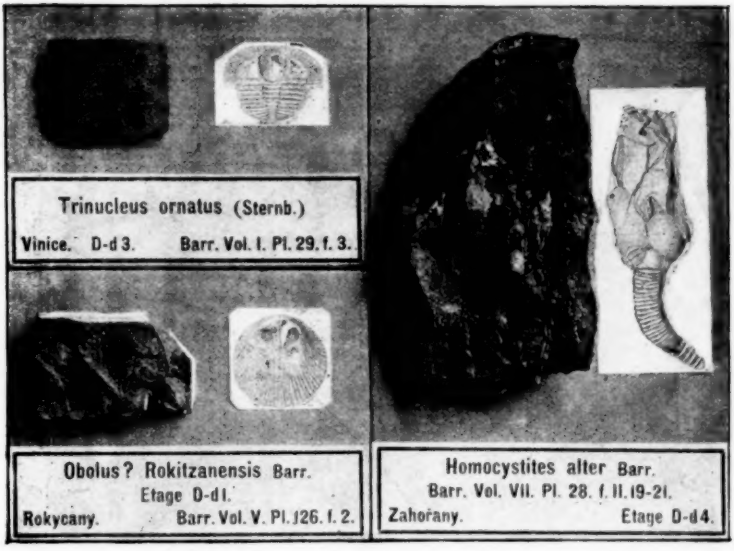

Trinucleus ornatus (Sternb.)
Vinice. D-d 3. Barr. Vol. I. Pl. 29. f. 3.
Obolus? Rokitzanensis Barr.
Etage D-d1.
Rokycany. Barr. Vol. V. Pl. 126. f. 2.
Homocystites alter Barr.
Barr. Vol. VII. Pl. 28. f. II. 19-21.
Zahořany. Etage D-d4.

FIG. 1.—SAMPLE OF MOUNTING EMPLOYED IN THE BARRANDE COLLECTION; HALF NATURAL SIZE.

which are all the original specimens figured by Count Caspar Sternberg in his "Flora Fossilis," and in the publications of Corda. A marble bust of Sternberg is placed opposite a central group of large fossil plants. One case containing the Arthropoda (scorpions, spiders, etc.) from the Coal-measures is of special interest.

Then follows a room in which the rocks and fossils of the Carboniferous and Permian formations are arranged in stratigraphical order, illustrating the papers of K. and O. Feistmantel, and where all the originals of Dr. A. Fritsch's "Fauna der Gaskohle" are exhibited, explained by figures from that work. One case containing the Jurassic fossils described by Geinitz and Bruder finishes the series.

The next three rooms when finished will contain specimens from

the Cretaceous, Tertiary, and Diluvial formations. The series opens with a collection of Cenomanian plants, consisting of more than 200 species, mostly conifers, cycades, and dicotyledons, described by Dr. Velenovsky. The marine fossils from Cenomanian to Senonian

FIG. 2.—NATURAL GROUP OF BATS (*Vespertilio murinus*) ON THE ENTRANCE OF A STALACTITIC CAVE.

are represented by the originals of Dr. Fritsch's studies of the Chalk formation of Bohemia, and of the monographs on fishes, cephalopods, and crustaceans published by him, and by Drs. Počta, Kafka, and others. Among the Tertiary fossils, the original land and fresh-water

shells from Tuchořic, described by Reuss, Slavik, and Klika, form a beautiful series. A smaller room, with the Diluvial Mammalia, closes this instructive exhibition of animal and plant remains found in Bohemia.

The general geological collection, for which the cases are not yet ready, will be placed in a room 26 metres in length, and opened to the public in three or four years.

The zoological collection begins with the Bohemian Fauna. The mammals are illustrated by natural groups of bats (Fig. 2), mice, etc. The birds are also shown in a life-like manner with nests

FIG. 3.—GROUP OF THE LIZARDS AND SNAKES OCCURRING IN BOHEMIA.

and eggs. Even the reptiles (Fig. 3) and amphibians are shown in groups taken from life. Among the fishes, the life-history of the salmon has received special attention. The lower animals, beginning with the Protozoa, are represented by models, drawings, and specimens as completely as possible.

Five large rooms have been devoted to the general zoological collection; but only typical forms are exhibited, intermixed with biological groups. In the mammal department a skeleton of *Balænoptera musculus* from Bergen, 23 metres in length, has been mounted with great care by V. Frič, together with a skeleton of an

embryo of the same species. Very beautiful examples of rhinoceros, antelopes, etc., have been presented by Dr. Holub and E. St. Vraz, two Bohemians, to whom the museum is much indebted for their generous gifts. The ornithological series contains many originals of Dr. Fritsch's work on the Birds of Europe, especially a young *Alca impennis* (the Great Auk) without the white marks in front of the eyes. An original bill of the dodo is also among the treasures. All the families and the principal genera of the reptiles, amphibians, and fishes are very completely illustrated, being in every case represented by one large stuffed example, skeleton, and anatomical preparations. Large instructive labels are already placed in many of the cases.

The general collection of lower animals will in the future occupy a large room, but I will only mention at present that living and extinct forms will be seen side by side.

The arrangement of the Bohemian Museum thus solves two problems: a local country museum and a type museum for the instruction of visitors, of whom in the last year there have been over 90,000.

ANTON FRITSCH.

III.

The Pigments of Animals.

Part II.

ANOTHER group of pigments which of late has been much studied includes those which are physiologically the ordinary nitrogenous waste-products of the organism in which they occur, or are produced by a modification of these. This employment of waste products in coloration is best exemplified in insects, especially Lepidoptera, but is also a familiar phenomenon in fishes. As regards the latter class, we have a beautifully illustrated research by Mr. Cunningham and Dr. MacMunn (3), which contains many interesting facts as to the part played by guanin in the coloration of the skin, especially of the Pleuronectidæ. In the case of butterflies there are numerous papers which require more detailed consideration.

The colours of butterflies are partly structural and partly due to pigment. The following colours are usually due to pigments:—white (in part), yellow, red (at least in part), brown, black (in part), and, very rarely, green. On the other hand, so far as is at present known, blue seems to be always a structural colour, green and white are usually structural, as is also black in part; metallic or changing colours are of course always optical effects. The distinction of the two kinds of colour, however, presents considerable difficulty in practice, and it is therefore not surprising that at this early stage of investigation there should exist some confusion as to their relations. This confusion has been to some extent increased by the fact that many of the pigments have been investigated only from the chemical side, and not by a combination of microscopic and chemical observations. A recent paper by Spuler (13), however, contains a careful summary of other researches, as well as an account of his own observations on butterflies' scales, which is of great assistance in the interpretation of the result of others. In spite of this, the uncertainty is such that the lists given above must be regarded rather as the balance of probabilities at the present time, than as a statement of assured fact.

As structural and pigmental colours in butterflies can thus not be very exactly separated, it is perhaps advisable to give some account of Spuler's results.

Spuler is primarily concerned with optical colours, which he finds

to be due either to the special characters of the individual scales, or to the relations of different sets of scales. Each scale consists of a double membrane, the parts being separated by a space which is continuous with the cavity of the stalk of the scale. The inner membrane is transparent, colourless, and usually slightly folded; the outer shows considerable differentiation and usually bears on its outer surface longitudinal rows of blunt projections, which are of much importance in the production of structural colours. The two membranes are connected by bridges of chitin. When pigment is present, it may occur in the form of granules or may be simply diffused through the chitin; it is always absent from the inner membrane, but it occurs freely in the bridges of chitin, in the stalk of the scale and its surrounding follicle, and in the outer membrane.

As to the exact nature of the pigments, our knowledge is still far from complete. The best known is perhaps the yellow pigment of the Pieridæ, which for some time has occupied the attention of Mr. F. Gowland Hopkins (4), (5), (6). This pigment is soluble in hot water, but not in the usual organic solvents (alcohol, chloroform, benzol, etc.); it gives the murexide reaction quite distinctly, is acid to litmus, and undoubtedly a derivative of uric acid. In the wings of the Pieridæ, indeed, uric acid itself is said to occur as a white pigment. According to Urech (16), however, the white scales of *Pieris brassicæ* appear yellow by transmitted light, and when treated with hot water yield a yellow solution which, besides yellow pigment, contains a white "crumbly" substance. This observation makes it appear doubtful how far even in this case white is an optical effect. White is certainly in most cases in butterflies an optical colour; in many cases it changes according to the direction of the light. In these cases, Spuler is inclined to think that it is produced by the relations of the layers of chitin in the scales. The phenomenon is thus to be explained as due to the interference colours of thin plates. It is interesting to compare the result obtained by Urech in the case of *Pieris brassicæ* with the observations made by Krukenberg on birds. Krukenberg (7) found that even the apparently pure white feathers of a cockatoo yielded a solution containing the yellow pigment characteristic of the family.

The yellow pigments found in the other Lepidoptera are not as yet well known; they do not all give the murexide reaction, nor are they in all cases soluble in water.

Among the other pigments, the red presents some interesting features. It has been noticed by several observers that in many cases scales of a bright red or scarlet colour yield a *yellow* solution when treated with hot water, but if the solution be evaporated to dryness a *red* residue remains. Similarly, the red colour is turned yellow by the application of acid, but the yellow colour may be restored by the addition of ammonia. This is the so-called "reversion effect" of Mr. Perry Coste (2). According to Hopkins, the red pigment is either formed from the yellow by hydration, or by the association of the yellow

acid body with a weak base. Red pigment showing this peculiar character occurs, for example, in *Delias eucharis* and *Deilephila elpenor*. The phenomenon is of common though not universal occurrence, some reds being quite unchanged by acids.

Green in butterflies presents many difficulties. It may be entirely structural, and arise by surface markings or by the superposition of scales, as in the species of *Nematois* (Spuler). Again, from the green scales of *Papilio eurymedes*, Urech extracted a yellow pigment which was almost insoluble in water, but which dissolved readily in hydrochloric acid. He adds as a note, however, that the scales retained their green colour after treatment with acid and ammonia. It is almost impossible to doubt that in this case the green colour is structural, the part played by the yellow pigment being uncertain. Further, he found that the green scales of *Thecla rubi* are yellow by transmitted light, and almost colourless when the light falls from the base of the scale upwards, while to hydrochloric acid they yield a yellow pigment. These two cases seem to suggest that in butterflies, as in birds, green may be produced by a combination of a yellow pigment and a structural modification. On the other hand, from the green scales of *Sphinx nerei* Urech extracted a pigment which was slightly soluble in water and readily soluble in acid and ammonia. Of the three solutions the first was greeensh yellow, the second orange yellow, and the third green. The addition of ammonia to pigment turned yellow by acid restored the green colour. This fact would suggest that the green pigment of *Sphinx nerei* is derived from a yellow, in much the same way as is the red pigment of *Delias eucharis*.

So far we have treated of four colours which are either always or occasionally produced by pigment, viz., white, yellow, red, and green. Of these the white pigment is uric acid itself (?); the yellow (lepidotic acid of Hopkins) is, at least in the best known cases, undoubtedly a derivative of uric acid, and in the Pieridæ has been found to occur as one of the normal waste-products of the organism. Further, the relations of red and green respectively to yellow render it probable that these pigments also are derivatives of the uric acid group. It must not be forgotten, however, that in various butterflies there occur yellow pigments which do not give the murexide reaction, and whose affinities have yet to be determined. For example, the yellow pigment of *Papilio machaon* when tested with nitric acid and ammonia gave a green instead of a purplish colour. In view of this and similar facts, it would seem to be premature to assert that all yellow pigments, even in butterflies, are directly derived from uric acid.

We have in the foregoing account omitted all reference to the black or brown pigments. Black is usually due in part to the sculpturing of the surface, and in part to a dark granular pigment. All these dark-coloured pigments Urech found to be insoluble in water and organic solvents, but to dissolve in most cases

(imperfectly ?) in acids. They never gave the murexide reaction. From Urech's description there can be little doubt that these pigments belong to the widely spread group of the melanins, which are chiefly characterised by their colour and their insolubility; their chemical relationships are unknown.

Looking now at the colours of butterflies in general, we may note that the *characteristic* pigments are derivatives of the uric acid group and melanins. Lipochrome pigments seem to be entirely absent in the adult. This is a very interesting fact, not only because lipochromes are so widely spread and so common as colour-producing agents, but because, as we have already seen, they are usually so important in the coloration of the larvæ. Again, there are many interesting analogies in the coloration of birds and insects, and yet in birds lipochromes are characteristically the pigments of the plumage, and waste products are not known to occur as colouring agents. Such facts as these must be explicable in terms of the physiology of the individual, and must, therefore, be allowed for in the construction of theories as to the origin of colour.

So far we have been concerned only with observed facts, but this paper would be incomplete without some reference to the conclusions which have been drawn from these facts. It has been repeatedly noticed that in the development of the individual a certain succession of colours can be seen. Thus in *Vanessa urticæ* towards the end of pupation, the wing-scales are white, and the development of the coloured elements takes place in the following order:—yellow, orange, red, red-brown, dark brown, and finally black. Urech, Eimer, and others believe that this ontogenetic succession corresponds to the phylogenetic order of the development of the characteristic colours. Urech, indeed, compares the succession of colours to various organic series where successive steps in substitution are associated with colour progression. He regards greenish-yellow or yellow as the simplest pigment, and says that, as the molecular weight increases, there is a colour progression through orange, red, violet, to blue and finally green. The cause of this increase in molecular weight he holds to be the influence of external conditions, such as better food and warmer climate; as to the nature of the effect and the question of inheritance, nothing is said.[1] He considers that the pigments arise from uric acid and from the allied nuclein bases (xanthin, hypoxanthin, adenin, guanin). Their proximate origin is from leucocytes, and their ultimate origin from nuclein, which undergoes spontaneous decomposition into the nuclein bases, albumin, and phosphoric acid. In connection with this suggestion, Urech notices the frequent occurrence in the scales of colourless substances which are associated with pigment, and, according to him, are derivatives of uric acid.

[1] Since this was written, a suggestive, if somewhat vague and mystical, paper has been published by Simroth (*Biol. Centralbl.*, xvi., pp. 35–51; Jan., 1896), who works out in detail a similar view as to the evolution of colour.

Urech's suggestions, though of great interest, are difficult to work out in detail, and are probably premature. As to the significance of the colour change in the *Vanessæ*, opinions are still divided. Spuler opposes the theory of its phylogenetic significance and the correlated assumption that the *Vanessæ* were once all white. Certainly, at the present time, the trend of scientific opinion seems against such detailed applications of the Recapitulation Theory.

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M. I. NEWBIGIN.

IV.

A Rowing Indicator.[1]

IT is curious that, in a pastime which so readily lends itself to experiment as rowing, little has yet been done to investigate many questions of interest to the physiologist, as well as to the oarsman. Such researches as have hitherto been made have generally been carried out without the aid of special apparatus, and have in consequence been very indirect.

The valuable researches made in Oxford more than twenty years ago by Dr. Parkes and Mr. Maclaren will serve as an example. Their object was to ascertain the value of a "man-power" in rowing, and they appear to have been received as the standard results on the subject.[2] The resistance offered by the water to a racing eight travelling through it was obtained by means of a dynamometer attached to the tow-line dragging a loaded eight at a rate of 2·65 knots. Assuming the resistance to vary as the square of the velocity, and that at racing speed an eight travels at 8·57 knots, a calculation was made of the work expended by each member of the crew in a given time. The two necessary assumptions are sufficient to render this reasoning hazardous. The calculation, moreover, neglects the fact that men and oars are very different to their equivalent ballast in sandbags. First, there is very considerable wind-resistance which the ballast does not set up. Any oarsman will realise the meaning of this, remembering that, not only the body, but the oar—and especially the blade in the swing forward—has to be reckoned with. Secondly, a portion of the energy expended in rowing is devoted to communicating kinetic energy to the water at the blade, so that this experiment takes no account of the swirl or "wash" left behind in the water.

The "Indicator" (Fig. 1) affords a means of *directly* measuring, not only the whole work done by any particular oarsman, but also of the way in which the work is done. In general principle the instrument is similar to the ordinary steam-engine indicator, but the diagram obtained is necessarily rather more complicated than the familiar "indicator diagrams."

[1] From a paper read before the Oxford University Junior Scientific Club, November 15, 1895.

[2] Haughton's "Principles of Animal Mechanics."

The indicator replaces the back thowl of the rowlock, so that in rowing the stroke the oar presses against the front face (BC, Fig. 2) of the instrument with the button at C. The instrument consequently turns with the oar, and carries the indicating point, E, over the card fixed to the plate, DD. If the stroke could be rowed without pressure against the indicator, the indicating point would simply

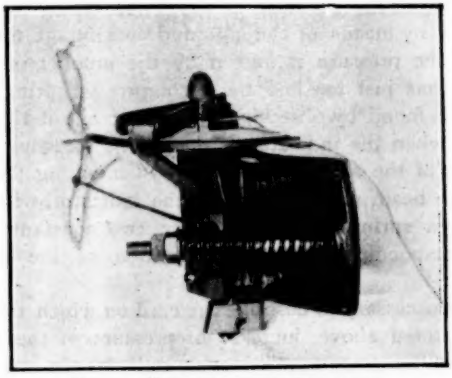


FIG. 1.—PHOTOGRAPH OF INDICATOR.

describe a circle. Pressure, however, tends to drive the face back and make the back-plate, AI, turn about B and compress the spring, SS, and then the pencil moves nearly radially outwards. The plate, DD, is fixed to the axle, A, which at its bottom end screws on to the

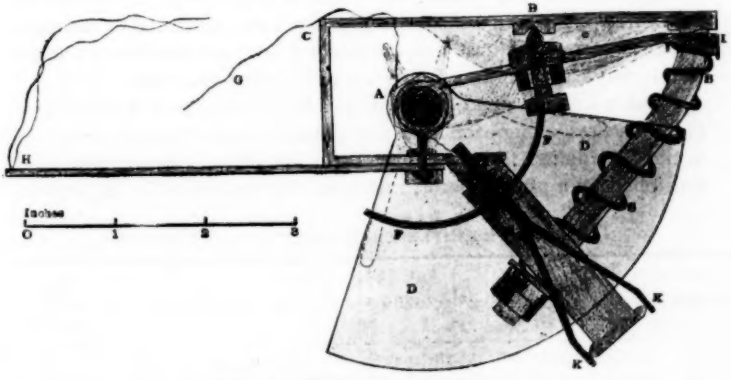


FIG. 2.—PLAN OF INDICATOR.

outrigger. In this way, while rowing the stroke, a diagram (Fig. 3) is drawn, the "base-line" being formed as the oar is coming forward. The pencil (in reality a brass point working on "metallic paper") is fixed to an arm which turns freely about the pivot, K, and is usually held off the card by a rail (FF). The diagram, then, is only traced when the rail is depressed by a string (G), which is under the

control of the coxswain. The wire and string (H) move the indicator forward, when, of course, the oar is no longer pressing against it, and admits of free "feathering," while securing that the indicator shall be in position for the next stroke. The instrument is reversible, to admit of use on bow and stroke side. In using the instrument it is convenient to be able to regulate the initial pressure of the spring (*i.e.*, the pressure at which the spring *begins* to close). This is done by means of the nut and locknut at the end of the spring, and the pressure is known by the number of turns given, after the nut has just touched the uncompressed spring. The value of one turn is found by observing the movement of the pencil over the diagram when the indicator is opened by screwing up the nut. The strength of the spring was found by comparing the *compression*, produced by a beam pressing against the indicator, with the *pressure* measured on a spring balance. These two constants enable the pressure corresponding to a given position of the pencil to be determined.

It is now necessary to describe the card on which the diagram is drawn. As stated above, increase of pressure of the oar (without turning) moves the pencil approximately radially. In reality, it moves in a circle, parallel to that described by the joint, B, about A as centre. In the cards used these pressure lines are drawn 5 degs. apart. The pressure is found along each of these lines by adding the initial pressure to that corresponding to the distance from the base-line to the upper line of the diagram (Fig. 3).

To observe the nature of the stroke, it is best to reduce the diagram to a form in which the pressures are measured as ordinates perpendicular to the base-line, corresponding to the position of the oar. In this way the diagrams in Figs. 3 and 4 were obtained.

Table I. illustrates the way in which the diagram is measured up. The pressures along each line are simply added together, and a correction is applied for the ends of the diagram. The result, when multiplied by a proper factor, measures the work done in the stroke.

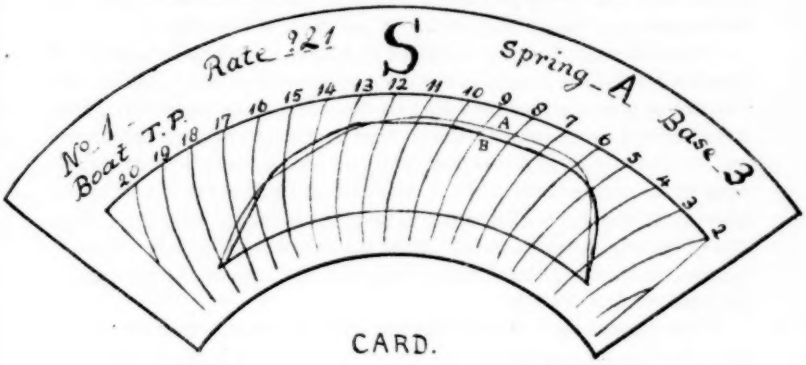
TABLE I.—EXAMPLE OF REDUCTION OF DIAGRAM.

Number.	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	End Correction.	Total.
1 (A)	40	78	127	161	177	180	180	181	173	169	160	148	129	109	91	68	46	[.2]	+5	2222
(B)	40	78	133	161	166	160	162	165	161	162	160	158	142	118	91	60	[.6]	..	+20	2137

The "end correction" arises from two causes. The first is the geometrical fact that the sum of the ordinates is in excess of the required quantity (the area) by half the sum of the end ordinates. The second cause is the initial pressure of the spring. In consequence of this the diagram terminates before the line of zero pressure is reached. Allowance is made for this by graphically estimating the

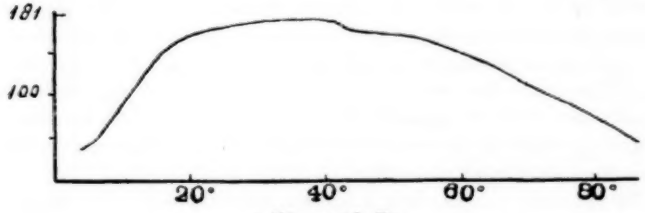
FIG. 3.

INDICATOR CARD, WITH THE REDUCED DIAGRAMS. NO. 1.

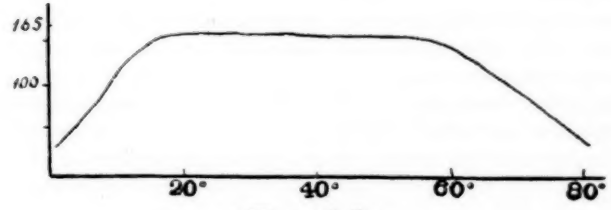


Finish. Beginning.

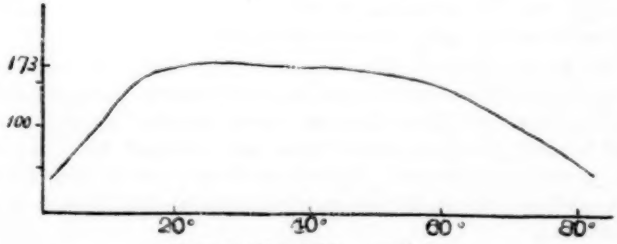
Beginning. Finish.



1 (A). 450 ft. lbs.



1 (B). 434 ft. lbs.



Mean of (A) and (B). 442 ft. lbs.

area enclosed by the true base-line, the ordinate at the end of the curve, and the curve produced down to the base-line. The two corrections together seldom exceed 1 per cent. of the whole.

The reduction factor is obtained as follows. To know the relation between *pull* on the handle of the oar and *pressure* on the rowlock, the "centre of pressure" of the blade on the water must be found. This was obtained by calculating the statical centre of pressure and allowing for the disturbing rotation (the position is thus known within 2 per cent. or 3 per cent.). The required result then follows from the principle of the lever. The ratio is found to be ·697. Finally, 5 degs. turn of the oar represents a motion of the handle of ·293 feet. Consequently, multiplying the results in Table I. by $\cdot 293 \times \cdot 697 = \cdot 203$ gives the result in foot-pounds.

The present form of indicator has various sources of error, all of which have been considered and found to have only a small effect on the result. The effect of friction was found at a pressure of 200 lb. to be about 1 per cent., and even this largely cancels, since the effect at one end of the stroke is opposite to that at the other. The compression of the spring is not strictly proportioned to the pressure, owing to the peculiar form of the instrument, but the variations were too small to be observed in testing the springs. Finally, at the commencement of the stroke, the outward pressure of the button of the oar very slightly exaggerates the "beginning." This has no appreciable effect on the whole work done, and in comparing different curves the effect on all is similar.

To pass now to some of the results obtained with the indicator. The first point to be noticed is that each oarsman has a marked individuality, both with regard to style and amount of work done. This fact makes generalisations difficult, and reliable figures of the average value of a man-power can only be obtained by a very extended series of observations. Table II. exhibits some of the results already obtained. The division into "rowing" and "paddling" is necessarily somewhat arbitrary. In the latter class are included all cases in which the rower was not working his hardest.

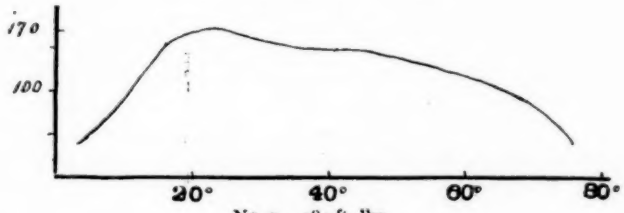
It has been found possible to indicate three or four strokes on the same card, and thus to obtain various stroke-diagrams in one piece of rowing. The stroke-rate was counted in the case of "rowing," but only estimated in the second class, and the 18 rate is possibly in cases 3 and 7 in excess or defect.

The results obtained show that in a "tub pair," in which it is only possible to row about 24 strokes to the minute, the horse-power at high pressure and short duration varies between ·23 and ·40. It should be said that these results have been obtained from oarsmen, all of moderate experience. All but one have rowed in their College Eight, and two—the reader will easily see which—have rowed in the 'Varsity Boat.

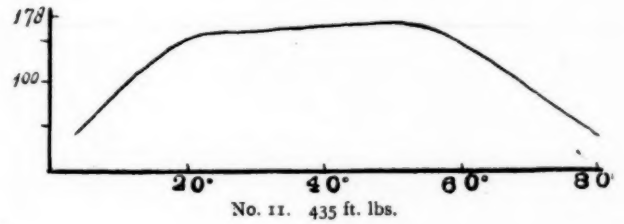
The diagrams reproduced will show the use of the indicator in

FIG. 4.

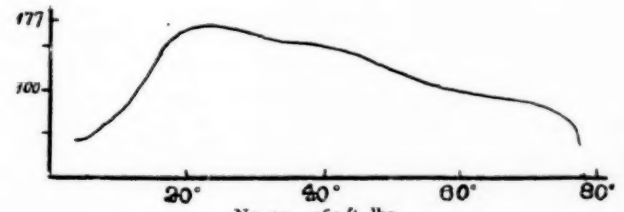
SOME OTHER STROKE DIAGRAMS.



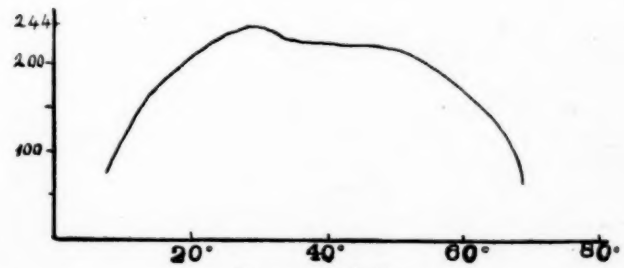
No. 7. 384 ft. lbs.



No. 11. 435 ft. lbs.



No. 13. 362 ft. lbs.



No. 15. 498 ft. lbs.

exhibiting "style" and determining some facts relating to what may be called the physiology of rowing. Fig. 3 shows a diagram actually drawn[1] and the figures reduced from it. In this case only two strokes were indicated. Fig. 4 consists of various other diagrams. The two strokes in Fig. 3 will be seen to be very similar, and to differ widely from any of the other diagrams, and generally it has been found that the stroke-curve of any "oar" is fairly constant, while it possesses a marked individuality. It is this fact that would make the indicator of assistance to the rowing coach in observing how far a pupil carries out his instructions, and what fault is most prominent. Compare, for instance, nos. 11 and 13 (Fig. 4). 11 has a slow "beginning," but rows his stroke firmly through, and achieves the very unusual result of reaching the highest pressure near the end of the stroke—suggestive of "pulling in with the arms" (of which,

TABLE II.

Number.	Duration.	Strokes Indicated.	Greatest Pull.	Foot-pounds.	Rate.	Horse-power.	Mean.
I.—"ROWING."							
1	1 min.	2	120	442	21	·282	
11	1 min.	2	124	435	21	·303	
13	1 min.	2	124	362	23	·242	
14	½ min.	2	117	351	22	·234	
15*	½ min.	2	166	498	22	·331	
16* †	½ min.	1	174†	602†	22	·401†	·299
II.—"PADDLING."							
3	..	2	116	362	?18	·198	
7	..	2	118	384	,,	·209	
10	..	4	117	383	,,	·209	
12	..	3	112	293	,,	·160	·194

All the experiments were tried in a gig pair.

* In the case of 15 and 16, two men were seated in the stern, in other cases only one.

† In 16, the instrument was completely closed during part of the stroke, so that the work was really in excess of that indicated.

indeed, he is independently known to be guilty). 13, on the other hand, has a smarter "beginning," and very soon reaches a maximum pressure, which, however, he is quite unable to carry through; a fall of pressure immediately follows, and the stroke continues at this pressure till past the middle of the stroke. Here another fall occurs, and the stroke finally terminates as it began, more firmly than that of no. 11. These results suggest that the indicator could be of assistance in choosing a crew, both with regard to strength and—so far as "blade" is concerned—"style."

These preliminary trials of the indicator have suggested many other experiments which should afford interesting results. The

[1] Unless the rigger is very steady, the beginning and end of the stroke-curve consist of dots instead of a continuous line.

author hopes at some future time to carry out at least some of them. The indicator could, for instance, be left working for a long time, and so indicate every stroke of a "course." The result would be a thick line formed by the mingling of all the stroke-diagrams. This would afford an accurate measure of the mean power over the course. A modification of the indicator has been roughly designed in which each stroke could be indicated separately on a tape. Unfortunately, the increased complexity of the machine and the time required to measure some 300 strokes would seriously diminish its utility. Another series of experiments which the author is anxious to try, is to compare the stroke-forms of the same individual in different boats. It is quite possible that whereas, for instance, no. 13 has what may be called a *false* beginning in a heavy tub-pair, he might in a light ship have a better stroke-form than no. 11, who, even in a heavy boat, has a slow beginning and finish.

An extensive series of experiments with the indicator might throw light on the very difficult question of the best proportions of oars; whether a fast stroke with oars having large handle leverage, or a slower rate with less leverage, is most efficient. That experience has not finally settled such questions is shown by the great differences in style between English and American rowing.

Such are some of the results and problems arising out of a first trial of the rowing indicator. Sufficient has been done to justify the author in the hope that his instrument is a step in the direction of the scientific study of rowing.

E. CUTHBERT ATKINSON.

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V.

Dispersal of Seeds by Birds.

THE dispersal of seeds to a place where they can germinate and develop is to a plant a matter of almost as great importance as the cross-fertilisation of the flower; and the modifications of the plant to ensure this end are worthy of more attention than has been paid to them. It is a subject which must be studied in the field, for, otherwise, many important points in the structure of the fruit or seed may not be intelligible. I have already published, in the *Journal of the Straits Asiatic Society*, vol. xxiv., p. 10, 1893, an account of the means of seed-dispersal by mammals in the Malay Peninsula, and I propose here to continue those notes by accounts of the other means by which seeds are disseminated, viz., by the aid of birds and insects, by wind, by streams and sea.

The subject has naturally a considerable bearing on the geographical distribution of plants, but I believe its value in this direction has been often over-rated. I have already (*loc. cit.*) pointed out that it is not to the advantage of any plant that its seeds should be borne to a very great distance, and I shall show that, except in the case of sea-borne seeds, the distance to which they are usually borne, and the journey for which they are modified, are really very short, and although numerous exceptions occur in which seeds are known to have been carried very far by natural causes, this is not the rule.

The study shows, not only how certain plants are found in certain localities, but also why certain groups are absent. Nothing in the distribution of orders in the Malay Peninsula is more striking than the paucity of Compositæ. Now, the Compositæ are a group in which the calyx is usually developed into a plume, by which the fruit is borne along by the wind. They are nearly all low herbs, so that, when ripe, the fruits are drifted along at no great height above the ground; they thus require open country for the dispersal of their seed, for a dense jungle, such as is common in tropical countries—especially if fringed, as it often is, with a tangled mat of creepers—stops the drifting seeds immediately at its edge. A clearing in such a jungle, if there is no direct communication with the open country, will remain free from plants of this character, but if a pathway of sufficient breadth is cut from the plain to the clearing, these plants

very soon make their way in. Now, the Malay Peninsula is almost entirely covered with jungle of the densest character, and the result is that Compositæ are almost entirely absent from the native flora. Along the open edges of the sea-coast, however, we have *Wedelia*, the fruits of which, unprovided with a pappus, are drifted along the coast in the sea: *Pluchea indica*, the fruits of which have a pappus, and are wind-dispersed; this latter, though usually a sea-shore plant, has been found by me on cleared ground in the interior of Singapore: *Gynura sarmentosa*, a climber to the tops of trees in the jungles, from which altitude its fruits can drift like those of other jungle-climbers: and *Vernonia arborea*, a lofty tree, which, however, occurs only on the outside of the jungles or in the open country. The remaining twenty-five or thirty species are apparently introduced weeds, and wander but a short distance from cultivated ground.

In some orders of plants the modifications for dispersal of seed are on the same lines in all the species, but in almost every order there are exceptional modifications. Thus the Orchideæ, whether epiphytic or terrestrial, have capsules filled with fine seed, the testa being prolonged into a thin process, by the aid of which the seeds are drifted to suitable spots by the wind. *Vanilla*, however, is an exception. It has a sweet, succulent, fleshy pod containing minute seed, unprovided with any prolongation. It is eaten by animals, and the seed is thus dispersed.

Most of the Apocynaceæ have plumed seeds, which are disseminated by the wind; they are here either climbers or large trees, more rarely shrubs. *Cerbera* and *Ochrosia*, natives of the banks of tidal rivers, have large drupes, which are adapted for sea-dispersal; *Kopsia* has an inconspicuous drupe with a single seed, and is apparently dispersed by mammals; *Willughbeia* and allied genera have large berries eaten by mammals and birds; *Tabernæmontana*, often a low shrub, inhabiting dense jungles, has a brilliant orange capsule, the seeds of which are enclosed in a crimson aril and are devoured by birds. Sometimes, however, very closely allied plants have entirely distinct means of dissemination; thus *Neuwiedia Lindleyi*, Rolfe (Apostasiaceæ), and *N. Griffithii*, Rchb. fil, have capsular fruits with seeds resembling those of orchids, while *N. Curtisii*, Rolfe, a plant which so closely resembles *N. Lindleyi*, Rolfe, both in habit and flower as sometimes to be hardly distinguishable at the first glance, has orange-coloured fleshy berries, with minute globose seeds, the testa of which is not developed into wings as in that plant.

Perhaps no group of plants shows so much variation in its means of dispersal as the Cucurbitaceæ. Thus *Bryonia*, a native of open woods and hedges where frugivorous birds are common, has small scarlet berries. *Trichosanthes*, on the other hand, a lofty climber in the tangled masses of creepers which fringe the jungles of the East Indies, has large scarlet fruit conspicuous from afar, but too large to be swallowed whole. The birds, therefore, tear it to bits, and as the

placentas are of a deep blackish green, a partially-torn fruit is even more conspicuous than an entire one, owing to the contrast between the two colours. A species of *Melothria*, which I found in Perak, is a small creeping gourd which frequents sandy spots. The fruit is dull-coloured and adapted for dispersal by mice, which tear the gourd to pieces and carry them away with the seeds. *Hodgsonia heteroclita*, Hook. fil., frequents dense thickets on river banks. It bears very large woody gourds, covered with a grey pubescence. These gourds drop from the plant, when ripe, and float in the river. The pubescence prevents them from injury by wet, so much so that a gourd may be plunged in the water and taken out again dry. The seeds, too, are large and woody; they float in water and are protected from injury as the pulp of the fruit is exceedingly oily. This is an example of modification for dissemination by water. *Zanonia macrocarpa* is a native of the densest hill-jungles of the Malay Peninsula and elsewhere. Here are few birds or mammals to disperse the seeds by swallowing or carrying them away, and no river to drift them. The fruit is therefore adapted for dispersal by wind. It is a huge obconic capsule, of a dull green colour; when ripe, it splits across the top into lobes, which recurve, and as, from its weight, it hangs with the broadest part downwards, the thin winged seeds drift away through the forest till they find a suitable spot to grow in. Finally, *Ecballium*, a native of dry deserts where animals and birds are few, and where there are no trees to climb up so that we might expect the seeds to be adapted for dispersal by wind, possesses a remarkable mechanism by which the seed is shot explosively to a sufficient distance from the parent plant. These examples, however, do not exhaust the minor modifications of the fruit in this remarkable order.

The methods by which seeds are dispersed may be briefly classed as :—

(*a*) Dissemination by animals, either by their swallowing the fruit, or seeds, or by bearing the seed to a distance in order to devour it, or part of it; or by accident in the case of adhesive seeds and fruits.

(*b*) By wind.

(*c*) By water; rain-drops, streams, or sea.

(*d*) By mechanical means, such as an explosive mechanism, by g, or by the mere inversion of the capsule.

It may be well to point out first that Epiphytes are invariably disseminated either by birds or by wind, and Saprophytes by merely shaking the seeds out of their capsule, or by dissolution of the whole fruit, when the seeds are carried away by rain-drops, or (more rarely) by wind; but in no case are they provided with plumes or other appurtenances for wind-dispersal. Big trees and lofty climbers in jungles and woods are disseminated by animals or wind, unless habitually growing in or near the sea or rivers, when they are often adapted for water-transport. With very few exceptions it is her-

baceous plants alone that are disseminated by adhesiveness of fruits or seeds.

The present paper, however, considers only the first of the above methods, namely Dissemination by Animals, and especially by Birds, as exemplified by the plants of the Malay region. Mammals, birds, and insects, chiefly ants, are the living disseminators of plants. Of the former I have already treated in the paper referred to, and will only repeat that the fruits and seeds disseminated by them are almost invariably dull-coloured, green or brown, partly because so many frugivorous animals are nocturnal, when colour is useless, and partly because in thick jungles the animals are unable to see for any great distance on account of the density of the foliage, while birds, on the other hand, flying above the trees can easily detect coloured fruit at a distance and find their way straight to it.

Colour, however, especially red, occurs accidentally in fruits not destined to attract birds, and may be absolutely injurious to the fruit. It is most conspicuous in species of *Dipterocarpus*, *e.g.*, *D. pterygocalyx*, *D. oblongifolius*, Bl., *D. cornutus*, Dyer, and several species of *Hopea*, *Melanorrhæa Curtisii*, Oliv., and *M. Wallichii*, Br. (Anacardiaceæ). These trees have winged fruits of the most brilliant crimson or red, and when in full fruit are truly magnificent. I have seen nearly all the fruits on a tree of *D. cornutus*, Dyer, destroyed by monkeys, which devour the seed. *Parameria polyneura* is a climber (Apocynaceæ) which produces slender pods about two feet long, containing plumed seeds. The pods often become red and somewhat conspicuous when the fruit is ripe, and I have seen pods in which every seed was bitten out and eaten by some animal before it was ripe.

But, with these few exceptions, seeds and fruits destined for dispersal by wind or water are dull green or brown, and even in plants in which the persistent calyx or bracts are coloured to make the flower the more conspicuous, as in *Bougainvillea*, *Petræa*, *Congea*, etc., the calyx or bracts usually lose their brilliancy in fruiting, and become dull and inconspicuous.

The birds which play the most important part in seed-dissemination are the fruit-eating birds which are attracted by bright colours. Among the most prominent of them here are the common bulbul (*Pycnonotus analis*, Horsf.), the dark blue starling (*Calornis chalybea*, Horsf.), and the mynah (*Mainatus javanensis*, Osb.) The hornbills (*Buceros*, *Anthracoceros*, etc.) play a large part in the dispersal of the larger seeds such as nutmegs; the pigeons (*Chalcophaps*, *Carpophaga*, *Turtur*, *Treron*) eat all kinds of fruits, especially those of *Ficus*; the parrots, of which there are here but few species, also aid in dispersal; I have seen numbers of *Palæornis* at the fruit of *Macaranga populifolia* and other trees. The graminivorous finches (*Munia maja* and *M. atricapilla*) probably account for the dispersal of many of the grasses, not only by swallowing the fruits, but also by bearing away many of the adhesive ones in their feathers. It is also very probable

that the migrant waders, *Ægialitis*, *Tringa*, etc., carry seeds of marsh-loving and aquatic plants about in this manner; for a number of plants, such as *Rhynchospora aurea*, Vahl., which did not grow within a considerable distance of a stone tank in the gardens, appeared there after the visits of a snippet (*Tringa* sp.). But more direct evidence of the part played by these birds is wanted. Many other birds no doubt play an irregular part in dissemination. Mr. G. Clunies Ross tells me that on Cocos islands when the boobies are not nesting and have consequently left, the frigate birds (*Tachypetes aquila*) are unable to procure their ordinary food, which consists of fish taken from the boobies, and that they then swallow seeds of *Guilandina* and beans which they find floating in the sea, and on flying to the land vomit them up again; apparently merely using them to fill up temporarily the empty crops. In this way seeds of these plants may be carried to some distance inland.

In pointing out that coloured fruits are especially attractive to birds, it is not intended to imply that they do not seek brown or green fruits at all. On the contrary, many inconspicuous fruits are devoured by them, and the seeds thus dispersed; such are those of the Macarangas, *M. javanica*, Muell., with small brown capsules, *M. populifolia*, Muell., with green ones, which are popular with parrots and pigeons (chiefly *Treron* and *Turtur*); but there is no doubt that coloured fruits are cleared off with much greater rapidity than the dull-coloured ones.

It is not essential that fruits should be flavoured to our taste in order to induce birds or animals to swallow them. The *Macaranga* capsules, covered with a viscid gum most unpleasant to the mouth, the hot *Capsicums*, the drupes of the palm *Kentia Macarthuri*, the berries of the wild grapes (*Cissus* spp.), which have a most irritating effect on the mouth, and the poisonous fruits of *Sapium* are all highly popular with birds, and even the fruit of *Strychnos Tieute*, Bl., with its intensely bitter pulp, is eaten by civet cats. A large number of the wild fruits, too, though very astringent, are often eaten by birds or animals.

Here by far the commonest attracting colour is red, followed by orange and yellow, then come black, white, pink, purple, and blue, which last is by no means common. It is not rare to see two, and sometimes three, colours combined in the fruit or fructification, and these are usually red and black; red, black, and yellow; red and yellow, and black and white. Combinations of white with red, pink with black, and black with yellow occur more seldom.

Very many plants have red drupes or berries, especially those which inhabit thick jungles or the borders of forests, *e.g.*, *Fagrea fragrans*, Roxb., *Leucopogon malayanus*, Jack., *Piper caninum*, L., *P. nigrum*, L., and other peppers, *Anisophyllea disticha*, Baill., *Neuwiedia Curtisii*, Rolfe, many palms, *Kentia*, *Drymophlœus*, etc. Sometimes the peduncles of the fruit also become of a bright red when fruiting, making the plant

even more conspicuous. This occurs in *Jackia ornata*, Wall. (Rubiaceæ), and *Medinilla Hasseltii*, Bl. (Melastomaceæ).

One very simple way in which red and black are combined is that the fruits pass through a red stage before turning eventually black, and as they are not all equally ripe at the same time, the different colours on the plant make it the more conspicuous. This is well seen in *Rhodamnia trinervia* (Myrtaceæ), and *Gynotroches axillaris* (Rhizophoreæ), common trees in open country. In the epiphytic *Heptapleurum subulatum*, the drupes pass from yellow to red and finally to black, giving a very striking effect. Sometimes the rachis or branches of the inflorescence are red, while the fruit is black; examples of this are *Nenga Wendlandiana* and *Cyrtostachys Lakka*, among palms, and *Phœbe opaca* (Laurineæ). *Pterisanthes* is a remarkable vine which has the rachis developed into a thin flat lamina in which the female flowers are embedded, the males being borne on stalks on the edge. This lamina, when the plant is in fruit, becomes of a bright-red colour, the grapes, which are sessile upon it, being black.

Sometimes the peduncle of the fruit is swollen and red, while the fruit is black or brown. In these cases it is the peduncle which is the eatable portion, the fruit or seed being protected in various ways from injury by the disseminator. Such fruits are those of the well-known cashew nut, *Anacardium occidentale*, L., a plant very commonly dispersed by birds, and *Semecarpus Anacardium*, L. In both of these the testa of the seed is charged with a black acrid resin which protects it from injury. *Dehaasia* (Laurineæ), *Podocarpus neriifolius*, and *P. cupressinus* are also examples of this colouring. *Scleria malaccensis* is remarkable for being one of the few Cyperaceæ modified for the purpose of attracting birds; in it the disc upon which the nut is seated is enlarged into a red cup with lobed edges, while the nut is dark brown or black. The combination of a red calyx with a black berry, though not very common, is a very striking form of colouring. It occurs in *Clerodendron disparifolium*, *C. nutans*, *C. myrmecophilum*, and *C. Siphonanthus*. In these the calyx, which is green in the flower, develops in fruit to a considerable size and becomes bright red, spreading out so as to set off the black or deep black-green berry. In *C. elegans* the flowers, which are clustered in a head, are white with red calyces, and the berries are black, so that the red calyx sets off the white flower first, and is utilised also to show off the black fruit. *Ixora Clerodendron* has the same arrrangement, and much resembles *C. elegans*.

One of the most remarkable modifications for dispersal that occurs here is in the fruit of *Erythropalum scandens*, Bl. (Olacineæ), a climbing shrub usually to be found on the borders of jungles. The drupe, which is about an inch long, is at first red; when ripe the outer coat splits into several lobes, which are recurved and resemble the petals of some scarlet flower, while in the centre stands the single

deep-blue seed. This plant seems very attractive to birds, as seeds seldom remain very long on the pedicels.

Pink fruits are comparatively scarce, being less conspicuous than red. The pink grapes of *Cissus Hookeri*, Laws., are, however, very showy. They are as large as cherries and of a beautiful translucent pink. The most interesting plant in which pink serves as an attracting colour is *Harmandia Kunstleri*, King (Olacineæ). This is a tree with small inconspicuous green flowers, but, when fruiting, the calyx develops into a large pale-pink disc two inches across, in the centre of which stands the black oblong fruit.

Yellow drupes and berries are very common, and nearly all are inhabitants of dense jungles. Such are the various species of *Urophyllum*, some species of *Cissus*, *Chrysophyllum Roxburghii*, Don, some species of *Heptapleurum*, *Mimusops elengi* and *Microdesmis casearifolia*, Don, and *Champereia* (Santalaceæ). Many figs, *e.g.*, *Ficus vasculosa*, *F. urophylla*, have yellow syconia.

Black drupes, or berries, are commonest among the plants of the open country. It is comparatively rare to find them in the deep jungles, where they would naturally be inconspicuous. Indeed, when they do occur in jungle plants, they are usually set off with a red calyx or rachis, as has been already described. *Brucea sumatrana*, Roxb., *Matthaea sancta*, Bl., *Rhodamnia trinervia*, Bl., *Cissus diffusus* (Miq.), *Vaccinium malaccanum*, Wight, *Clidemia hirta*, Don, *Alpinia allughas*, L., are examples. *Geophila melanocarpa*, Ridl., however, a low herb which inhabits dense woods, has black berries like black-currants, and is certainly by no means conspicuous. *Melastoma polyanthum*, Bl., frequents open sunny spots, and its fruit, of a dull pinkish colour, would be very inconspicuous if it did not, when ripe, split transversely and disclose a black pulp containing its minute seeds. This black mass is very conspicuous, and few plants are so freely disseminated by birds as this one. A number of black-fruited trees, such as *Dialium*, *Cryptocarya*, *Parinarium Griffithianum*, Benth., are chiefly disseminated by mammals, such as monkeys and civets, as described in the paper above referred to. In *Chasalia curviflora*, Thw. (Rubiaceæ), a low shrub found in open woods, the black drupes are set off by the thickened white peduncles and branches of the inflorescence.

White berries and drupes occur commonly in plants growing in damp spots in dense jungles, such as *Adenosacme longifolia*, Wall., *Chloranthus officinalis*, *Alpinia scabra*, Bl., *Elettariopsis longituba*, Ridl., *Gomphostemma*, most of the climbing *Psychotrias*, *Pimelandra Wallichii*, Dec., *Aglaia glabriflora*, Hiern., *Clinogyne grandis*, Benth., and *Hedyotis congesta*, R. Br. This latter is especially interesting, as it belongs to a genus in which nearly all the species frequent open country and have capsular fruit. There are also a number of white-fruited plants which occur in sandy open woods near the sea, and in these the fruits are usually massed together so as to be more conspicuous. *Euthemis leucocarpa*, Jack., has the berries either snow-white, deep rose-colour,

or crimson-scarlet, and *Sauropus albicans*, Bl., the fruits of which are usually white, sometimes has them rose-coloured. *Fluggea microcarpa*, Bl., *Callicarpa longifolia*, Benth., *Psychotria sarmentosa*, Bl., *Cissus carnosa*, Wall., and *Cyclea Arnotti*, Miers, are natives of river banks and hedges. They have small or medium-sized fruits, of a pure white, often massed together and very conspicuous.

Several of the Eugenias, *e.g.*, *E. zeylanica*, Wight, *E. lineata*, Bl., are very conspicuous when in fruit, being loaded with small snowy drupes, which are much sought by birds. A rather curious arrangement is found in *Sloetia sideroxylon*, Teysm. (Urticaceæ). When the fruit is ripe the green perianth is found to have increased very much in size and become of a whitish colour, and the inner pair of lobes is quite white, swollen, and fleshy, and sweet and eatable. These lobes grasp tightly the pea-shaped nut, and when a bird or other animal bites the fleshy petals the nut is shot out to a short distance, and so not only escapes injury from the animal, but is also thrown to some distance from the tree.

Blue is, perhaps, the rarest of all colours in fruits, that is to say pure blue, for there are a number of fruits of a deep steely blue which at a little distance appear black, such as those of *Cinnamomum iners*, Bl. Pure blue occurs in a few plants which inhabit dense dark jungles. Nearly all the *Lasianthi Cephaelis* (Rubiaceæ), *Symplocos fasciculata* and other species, *Dianella ensifolia*, Red., are the only blue-berried plants I have seen here. *Peliosanthes*, however, has blue seeds which are exposed in a remarkable way. The pericarp of the fruit does not increase in size concomitantly with the seeds, but is pierced by the latter, which eventually become of considerable size and drupe-like, with a thick eatable testa of a light blue colour. In some of the *Lasianthi* and *Dianellæ* the fruits are at first white, changing to blue, and sometimes they remain white even when apparently ripe. Blue is really more conspicuous than white in thick jungle where the flecks of sunlight on the wet leaves look white, and prevent isolated white fruits from being as conspicuous in the dark woods as might be expected.

Purple and violet fruits are not very common but are sometimes to be met with. *Eugenia acuminatissima*, Kurz., *Dissochæta gracilis*, Bl., *Anplectrum glaucum*, Triana, *Callicarpa rubella*, Benth., and a few others, possess purple fruits, which, however, usually look black at a short distance. They occur in open places, like most of the black-fruited plants. Many capsular fruits are brightly coloured, and in this case it is usual for the seeds to be provided with either an edible testa or an aril. Sometimes the whole fruit becomes soft and is eaten like a berry; indeed, in these cases it is sometimes difficult to decide whether the fruit is to be called capsular or baccate. *Xiphidium floribundum* Aubl. (Hæmodoraceæ), a native of South America, is an example of this. The fruit is a nearly globose orange-red capsule, the walls of which are pulpy and sweet. The cells in the ripe fruit are not filled up with

outgrowths from the walls or developed placentas, as is the case in a berry, but there are large spaces between the seed and the cell-walls. Its appearance suggests that it is a capsule becoming baccate.

The variations of the arrangements for the dispersal of the seeds of capsular fruits by birds seem almost endless, and only a few of the more striking and commoner forms can be here described. As in the drupes and berries, red is the most common attracting colour. Frequently the capsule is red and the seeds are black, red, or yellow, or provided with a red or yellow aril. One of the most showy fruits is that of *Sterculia rubiginosa*, a common tree. The capsule is of an intense crimson-scarlet, and when ripe each carpel splits widely and exposes the black oblong seeds hanging from the edge by the raphe. Beneath the black testa is a thin white pulp, which is the only eatable part of the fruit. This appears to be highly appreciated by birds, which devour the seeds as soon as they are ripe. *S. parviflora*, has the same arrangement, but the capsule is pink and less showy, and I note that the seeds are less popular with birds, the ground beneath a fruiting tree being covered with fallen seeds, which is not the case with the other brighter-coloured species, *S. rubiginosa* and *S. lævis*. A somewhat similar arrangement occurs in *Pithecolobium* (Leguminosæ). Here the pod, which is often curiously contorted, is of a bright orange-red, while the seeds are black; and in *P. fasciculatum* the seeds, very much like those of *Sterculia rubiginosa* in appearance, are pendulous and conspicuous and very soon carried off by birds. *P. lobatum* is an exception to this plan; the fruits and seeds are very large, too large to be taken off by any ordinary bird. They are dispersed by squirrels, and, as in all plants dependent on mammals for dispersal, they are not gaily coloured, the pod and seeds being of a dull brown. I once saw a squirrel running with one of these seeds in its mouth fully a hundred yards from the tree. It dropped the seed, which I found to be quite sound, though it had nibbled off much of the testa.

Ternstræmia penangiana is commonly described as having a baccate fruit, but it should rather be described as capsular. It consists of an elliptical scarlet capsule which splits open and permits three or four crimson seeds to hang out. The crimson outer covering, apparently part of the testa, is eatable, and a tree in fruit with the scarlet and crimson fruit standing out against the deep green leaves is very showy.

In some plants, such as *Gardenia tubifera*, a common tree in jungles, the outside of the fruit, which is generally spoken of as baccate, is of a dull green colour and quite inconspicuous, but it breaks open irregularly, and then the inner lining of the woody pericarp is seen to be of a bright orange, setting off the black seeds which are enclosed in a sweet shining substance.

Fagræa imperialis is an interesting example of modification ot the arrangement for dissemination entailed by the modification of other parts of the flower. The genus to which it belongs consists of

a number of species very different in the size of flower. *F. fragrans*, with small flowers in corymbs, has small orange berries, dispersed by birds and bats. *F. zeylanica* has large flowers and globose grey berries an inch and a half in diameter; too large for our small birds, and thus adapted rather for dispersal by civets. *F. imperialis* has enormous flowers, followed by correspondingly large fruit six inches long and conical in shape. It would be impossible for any of our birds to carry them away whole, so some modification becomes necessary. The fruit, which is of a grey colour outside, splits vertically, and the segments enclose an orange-coloured conspicuous pulp easily accessible to birds, which must swallow the minute seeds with the pulp. Unlike the fruits of *F. zeylanica* this fruit is not readily detachable, as it would not be to the advantage of the plant were it to fall off easily; whereas in *F. zeylanica* the fruit readily falls off whole without ever splitting, and it being intended to be taken whole by nocturnal animals, the pulp is not coloured.

One may compare the arrangement in *F. imperialis* with that in *Momordica Charantia*, a pumpkin half wild, and cultivated all over the tropics. This pumpkin is, in many forms at least, too large for birds to carry off whole. It therefore splits, and the segments recurve and expose the seeds lying in a sweet crimson aril.

In this case, however, the fruit itself is of a brilliant orange, and the colouring of the segments sets off the crimson seeds well. Its appearance suggests that at one time the fruit was small and eaten whole; but as it increased in size and its disseminator was unable to carry the whole fruit off, it was so far modified that it practically became capsular with arillate seed so as to suit the exigencies of the case. In very many capsular fruits the seeds are provided with an eatable aril of very variable size, sometimes so small that one wonders that birds or mammals should find it worth while to seek it. *Dysoxylon cauliflorum* (Meliaceæ) is an excellent example. The capsules are about an inch long, ovoid, and of a bright orange-red. They are borne on the trunk of the tree, and, when ripe and split, stand horizontally, the apex facing the spectator. The seeds are black and from two to four in number. On the apex of the inner face of each is a small but conspicuous orange aril not a quarter of an inch long. This is the only part eaten, and I can perceive no taste in it, yet it is a most popular fruit, being eaten, not only by birds, but also by squirrels and Tupaias as soon as it is ripe. *D. acutangulum* has a very large orange capsule, as big as a small pear, in each cell of which is a single large black seed with a yellow aril, forming a contrast of three colours. Another species of *Dysoxylon* (*D. angustifolium*) is chiefly remarkable for its capsule being creamy white. It splits at the apex and discloses three or four seeds covered with a thin crimson aril, which is very sweet.

The split carpels of the *Wormias* (Dilleniaceæ) are nearly as showy

as their beautiful flowers. In *Wormia suffruticosa*, a large shrub common in the south of the Peninsula, the carpels, when ripe, split and spread out in the form of a large pink rosette, exposing the small black seeds provided with a sweet red aril. The seeds are carried off by birds very speedily, and so well disseminated that the plant appears in all kind of odd places. *W. tomentella* has the same arrangement, but the carpels are white. In the allied genera *Delima* and *Tetracera*, the carpels are small and of an inconspicuous brown colour, but the black seeds are ornamented with a fimbriated crimson aril, which only partially covers them.

The form of the fruit of the common nutmeg (*Myristica moschata*) is well enough known, but it is interesting to compare it with those of others in the genus. In *M. moschata* the pericarp is dull yellowish, the aril a loose crimson network partly covering the black testa of the seed. In *M. Farquhariana* the pericarp is of a bright orange-pink, while the aril is yellow and completely covers the seed. In this case, and in all other similar ones that I have seen, the testa, being covered completely with the aril, is merely brownish, and is not jet black, as it is in all cases where the aril does not completely cover it, for it is of no advantage to the seed to be fully black when the contrast of the two colours would not be visible. In a few wild nutmegs the fruit is bright pink outside and the aril yellow, but as a rule the pericarp is not very conspicuous.

The Euphorbiaceous genus *Baccaurea* is an interesting one in its variety of adaptation for dispersal. In *B. motleyana* the fruit is really baccate; that is to say, the pericarp is soft and leathery, and does not split. The berries are creamy-white, about an inch and a half long, and contain three or four seeds enclosed in a white translucent pulp. The fruit is produced on the trunk of the tree. In this position it is not easy for birds to see it or to get at it, and it seems to be exclusively dispersed by mammals. The fruit much resembles that of the Langsat, *Lansium domesticum* (Meliaceæ), which is dispersed in a similar way. In *Baccaurea parviflora* we have the fruit produced in masses at the base of the tree, where there is sometimes quite a large pile of it. It is deep claret-colour, practically black, the pericarp fleshy and eatable. It is, I believe, dispersed by mice, which carry off the fruits and drop the seeds about. Here the whole fruit is eaten.

Many species of *Baccaurea* bear their long racemes of fruit on the branches of the tree. The fruits are globose, or nearly so, and capsular. They are of a greenish, or more commonly yellow or orange-colour, but the pulp is bright orange. In most species, when the fruit is ripe the pericarp splits in three and falls off, leaving the seed enclosed in its sweet yellow pulp, hanging attached to the very long placentas (*B. minor*).

Before concluding, I would refer to the suggestion that has sometimes been made that some of the seeds of Euphorbiaceæ, notably those of the castor-oil plant (*Ricinus*), resemble beetles, and, as such, may be

mistaken by birds and carried a small distance before being dropped. This seems very doubtful. *Ricinus* seeds and those of Para rubber (*Hevea braziliensis*), which resemble them on a large scale, are ejected explosively from their capsules to a distance quite sufficient for their dispersal, and falling, as they constantly do, among other herbage, would certainly escape most insect-eating birds.

Mimicry in another form plays, I believe, a considerable part in ensuring the dispersal of such seeds as those of *Adenanthera bicolor* and *Abrus precatorius*. In the former, a big tree, the pod splits and allows the seed to hang out, as it does in *Pithecolobium*; the seed is half scarlet and half black, the effect at a little distance being that of a black seed with a red aril, the red, as is usual in arillate seeds, being at the base. A bird flying past the tree might readily pick off the seeds, under the impression that they were provided with an eatable aril, and would quickly swallow them. The seed is very hard, and cannot supply any nourishment to most birds, who would be unable to break it up or digest it. There is reason to believe that birds do carry away the seed, but, after fruiting, a considerable quantity is left beneath the tree. *Abrus*, which is a climber, may sometimes get disseminated in a similar way; but here, at least, it usually frequents sea-shores, and the seeds are drifted about in the sea, and may rather be classed as sea-borne. In *Adenanthera pavonina* and most of the *Ormosias*, the seed is entirely red and shiny, certainly suggestive of a soft, eatable aril, and I have little doubt, from the position in which I have found plants, that birds have borne away the seeds.

In order to show what an important part birds play in dispersal of seeds, I examined a number of trees in the botanic garden, such as oil-palms (*Elæis Guineensis*) and dates (*Phœnix dactylifera*), which, owing to the retention of the bases of the leaves, form a nidus for the growth of any seeds which have fallen therein. I give a list herewith of plants found on these trees.

On an oil-palm tree:—*Rhodamnia trinervia*, fruit a berry much sought by bulbuls; *Ficus urophylla*, figs orange, eaten by birds; *F. Miquelii*, figs dull red or green, eaten by fruit-bats. On another oil-palm:—*Clidemia hirta*, berry black, much sought by birds; *Fagræa fragrans*, berry orange, much sought by birds; *Ficus* aff. *Benjamina*, fig black, much sought by birds; and many ferns. On another: *Ficus* sp., *Clidemia hirta*, *Phyllanthus Niruri* (several plants very high up the stem).

On a sago-palm (*Sagus lævis*):—*Clidemia hirta*; *Macaranga hypoleuca*, capsules eaten by pigeons and parrots; *Melastoma polyanthum*, eaten by birds; *Ficus alba*, figs orange, eaten by birds; *F. Miquelii*; *Dacrydium cupressinum*, seed with red peduncle, eaten by birds; *Psychotria* or *Ixora*, drupe probably red.

On the stem of a date-palm (*Phœnix dactylifera*):—*Ficus urophylla*; *Phyllanthus urinaria*; *Davallia solida*; *Nephrolepis*; *Psilotum complanatum*

(the last three wind-dispersed). In the last case the greater part of the plants are wind-dispersed, as the tree is not well suited for birds to roost in, and the stem is much exposed to the breeze.

The greater part of this tree-flora is, it will be seen, composed of bird-disseminated plants, the remainder being wind-drifted, with the exception of the herbaceous *Phyllanthi*. I cannot suggest how these plants succeeded in getting so high up the trees.

But besides roosting upon trees, birds have a habit of frequenting bushes, and often drop seeds round the buttressed trunks of big trees. These spring up and form thickets; more birds come and bring more seeds, and so, eventually, woods may be formed. I have examined several instances of this in the Botanic Garden, which are very instructive.

A very lofty tree of a new species of *Terminalia* allied to *T. pyrifolia* has a big climber, *Spatholobus gyrocarpus*, at its base, which climbs to the top of it. Birds frequently roost there, and have produced a veritable thicket of shrubs between the stem of the climber and the buttresses of the tree, including: *Flacourtia cataphracta*, a tree with a dark red berry, very popular with birds; *Erycibe Princei*, berries dark red; *Passiflora laurifolia*, fruit eaten by birds and bats; *Pithecolobium lobatum*, seed carried about by squirrels, which very commonly frequent this tree; *Fibraurea tinctoria*, a large yellow drupe usually carried about by civets, but also, I believe, eaten by birds; *Clerodendron disparifolium*, berry black, with a red calyx, eaten by birds; *Scleropyrum Maingayi*, a shrub with green fruits (I cannot guess how this got here; it is a rare plant and I do not know of its occurrence within ten miles); *Agrostistachys longifolia*, a shrub, the seeds of which are dispersed by explosion of the capsule.

A large *Shorea leprosula* close by offers shelter to: *Pithecolobium lobatum*; *Passiflora laurifolia*; *Cupania pallidula*, a tree with red capsules and black seeds, with a yellow aril much sought by birds.

A large bush of *Bougainvillea spectabilis*, a favourite resort of birds, contains: *Embelia Ribes*, with red drupes very popular with birds; *Cissus sagittifolia*, grapes black; *Clidemia hirta*.

A large much-branched *Ficus* standing alone on the lawn bore between its stems many plants, some of which are now fairly large trees, namely: *Eugenia Jambos* and *E. grandis*; *Calophyllum Inophyllum*, these are usually disseminated by fruit bats, which roost in the tree; *Flacourtia calaphracta*, several plants; *Cinnamomum iners*; *Quassia amara*; *Arthrophyllum diversifolium*, fruit green; *Rhodamnia trinervia*; *Ilex cymosa*; *Olea maritima*; *Gomphia sumatrana*, drupes black on a red disc; *Cupania pallidula*; *Lantana Camara*; and *Caryota mitis*; of the last two the drupes are black and eaten by birds. Indeed, all these are commonly eaten by birds, their fruit being drupaceous or baccate, except *Cupania*, *Thunbergia laurifolia*, and *Ruellia repens*, the two latter having explosive capsules. The last is common in the surrounding grass.

These are examples of the results of dissemination by birds, and

it may be said that far the larger number of seeds are evidently brought from no great distance, a hundred yards or so at most, but other examples make this clear. *Kentia Macarthuri*, a palm cultivated in the gardens, the scarlet drupes of which are very popular with the blue starling (*Calornis chalybea*), constantly appears as seedlings within an area of about twenty yards; but looking all about the garden I cannot find any at a greater distance; *Olea maritima*, a sea-shore plant cultivated in the gardens, has spread for a distance of a hundred yards, and though it grows very well in many spots where the seeds have been carried by birds, yet I cannot find any plants beyond that radius. *Clidemia hirta* a South American plant, which was probably accidentally introduced into the gardens and is now a troublesome weed there, is confined to a very few spots in Singapore, and though abundant in these is extending its area very slowly. *Brucea sumatrana* was collected by Wallich in Singapore in 1822, but I have never been able to find it again here. However, in 1891 I brought seeds from Pahang, which grew and fruited, and now young plants often appear along the roadsides near the gardens, the seeds being carried about by birds. Birds, as a rule, it appears, remain about a tree so long as it has any fruits on it, and discharge the seeds in the immediate neighbourhood. That they do sometimes carry seeds to a great distance also is shown by the number of bird-disseminated plants in ocean islands; but this is probably very exceptional, as otherwise many local plants would be much more widely dispersed than they are. Further information is, however, required on this subject, and it is well worth the attention of field-naturalists.

H. N. Ridley.

Singapore.

SOME NEW BOOKS.

Darwin and After Darwin.

Darwin and After Darwin: An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions. By the late G. J. Romanes, F.R.S. II.—Post-Darwinian Questions: Heredity and Utility. Pp. x., 344. London: Longmans, Green & Co., 1895. Price 10s. 6d.

Professor Lloyd Morgan has edited this volume, and he tells us that he has made no substantial additions, as the greater part of the book had been prepared before the death of its author. The present volume consists of an Introduction, a section on Heredity, and a section on Utility. Isolation and Physiological Selection are reserved for a third volume.

In the Introduction, Professor Romanes distinguishes between the Darwinism of Darwin, what he calls the Darwinism of Wallace, and the neo-Lamarckian schools. He begins by a series of quotations, to show that Darwin did not insist on the all-sufficiency of natural selection, his point being to suggest that other naturalists are departing from orthodox Darwinism. Now we grant his quotations completely, and agree that they fully bear out the somewhat unnecessary proposition that Darwin, to use his own words, believed natural selection to have been "the main, but not the exclusive means of modification." With the minor means of modification, from use-inheritance to physiological selection, an indefinite number of names are associated; the name of Darwin has been and will be associated with the origin of species by means of natural selection. That was his theory: the other "causes" were mere shifting accessories; many of them accepted by Darwin, as by others, on trust, and not questioned until the passing of the years and the progress of knowledge threw doubt on them.

Section 1 of this volume deals with characters as hereditary and acquired. It is somewhat remarkable that Romanes himself, and his editor, allowed a large part of this section to stand. Those who are familiar with the controversy as to the inheritance of acquired characters will remember that Romanes chose to assume that Weismann made the non-inheritance of acquired characters a fundamental postulate from which to deduce his theory of the germ-plasm and his theory of evolution. It has been pointed out sufficiently often that Weismann did not begin by doubting the evidence of acquired characters, but that his conception of the continuity of the germ-plasm led him to doubt their inheritance and to examine afresh the supposed evidence in its favour. However, Romanes wrote his "Examination of Weismannism" on the double theory that non-inheritance was a fundamental postulate and that the slightest possibility of use-inheritance would be fatal to all Weismann's views. In his recently published "Life and Letters" we find that Romanes read the "Germ-plasm" only after he had written the "Examination of Weismannism," and that he thought it "a great nuisance" to find that Weismann had anticipated the points of all his longer arguments. Weismann had shown, in the plainest fashion, that his views of non-inheritance were inferential, not fundamental, and he had actually included the

possibility of the inheritance of acquired characters in his theory. Perhaps it was too much to expect from Romanes that he should have withdrawn or altered his "Examination"; but for this volume there was no excuse. Professor Romanes was not ignorant, and his editor has no business to be ignorant, that the attack upon Weismann is based on a position which Weismann does not hold.

The longer part of this section is devoted to a summation and criticism of the evidence in favour of use-inheritance. The most interesting and novel part of this is the suggestion that the acquisition of reflex actions furnishes indirect evidence in favour of use-inheritance. A brainless dog, for instance, will make scratching movements with its paws when its sides are irritated. Romanes suggests that even if the removal of parasites could have been of advantage in the struggle for existence, a dog with a brain would have removed them by a conscious act, and a reflex act, therefore, would not have been produced by selection. But the memory of the habit, if transmitted, might be the source of the reflex on the supposition of use-inheritance being a fact.

We admit freely the ingenuity of the argument. But we know too little of the real nature of reflex actions to base any sound argument upon the nature of their acquisition. Moreover, it seems to us plain that the possession of reflexes is of the highest utility to any creature. It is no answer to say that reflexes can always be replaced by conscious acts. Nothing is more difficult than to perform two conscious correlated movements of different kind simultaneously, as anyone may see who tries to card wool in different directions with each hand at the same time. The chapter on the direct evidence in favour of the inheritance of acquired characters gives an account of many experiments upon guinea-pigs and so forth, in which Romanes, following Brown-Séquard, tried to gain evidence of the inherited results of nervous lesions. The chapter only makes us regret more than ever the early death of the author. He was admirably patient in executing experiments, and brilliant in conceiving them. But he had not got nearly far enough to show positive or negative evidence of any validity. In fact, we feel that the whole of this section upon characters as acquired and hereditary has little scientific value.

The last section of the volume deals with characters as adaptive and specific. It is directed mainly against the position, urged with great force by Wallace, that all specific characters are either directly useful or are correlated with characters directly useful. Romanes' method is to produce instance after instance of characters whose specific nature is admitted, but whose utility it is impossible to see. For our own part, we find such arguments not a little futile. The study of correlations is in its infancy. Exact inquiry into the relations between death-rates and variations is equally young, and upon these two must depend any definite knowledge of the "way the wheels go round" in organic nature. None the less, this last section of Romanes' volume is exceedingly interesting, and more than justifies a book whose earlier part requires no small justification.

HENSLOW *versus* DARWIN.

THE ORIGIN OF PLANT STRUCTURES BY SELF-ADAPTATION TO THE ENVIRONMENT. By the Rev. George Henslow. Pp. xiii., 256; Int. Sci. Series, vol. 77 London: Kegan Paul & Co., 1895. Price 5s.

MR. HENSLOW aims high. He is going to prove that natural selection plays no part in the origin of species. In a former volume of the same series, "The Origin of Floral Structures through Insect and other

Agencies," he endeavoured to show that the direct action of the environment, coupled with the responsive power of protoplasm, were the sole and efficient causes of the forms of flowers; the object of the present work is to substantiate those statements for vegetative structures, "so that the two books taken together, it is hoped, will furnish a tolerably complete proof that the origin of all plant structures issues from self-adaptation to the environment (directly or indirectly), without the aid of natural selection."

There are twelve chapters. The first is introductory; in it the writer states his case and draws his conclusions. The rest are occupied with an account of the structural peculiarities of plants growing under certain conditions, such as desert plants, arctic and alpine, maritime and saline, aquatic; of climbing plants; of subterranean stems and roots; and of leaves.

We can recommend the book. Mr. Henslow has been at great pains to bring together a large number of facts, which will interest and instruct the reader and convince him that plants are more plastic organisms than he had probably imagined. But we do not think his opinion as to the value of natural selection will be at all influenced thereby. Before he has got through many pages he will be struck with the fact that Mr. Henslow's arguments may sometimes be used against his theory. For instance, in an early paragraph in the introduction on "The Supposed Requirements of Natural Selection," the author asks if there is any evidence, direct or indirect, that trivial morphological differences are of the slightest consequence to a seedling so as to enable it to survive in the struggle for life. "A seedling," he says, "survives among others solely because it is vigorous." But what *is* "vigorous"? In some cases it may mean larger cotyledons, giving it a greater assimilative area; or a taller stem, to lift those first leaves above its competitors; or a thicker cuticle, to withstand better the attacks of parasitic fungi, like that which is often so fatal to seedlings, the "damping off" fungus. He then instances several experiments, to which others might be added, that larger seeds will produce stronger seedlings than smaller seeds. That is to say, trivial differences in the seeds from the same capsule, such as in size or in amount of stored nourishment, or in a thinner or thicker seed-coat, *are* of great importance to the embryo in its development to form a seedling, and the experiments quoted by Mr. Henslow do indicate a selection by nature of the resulting seedlings, the basis of that selection being the trivial variations.

In the next section, on "Darwin's fundamental error," Mr. Henslow refers with regret to the large proportion of Darwin's work which was done on domesticated plants and animals. The evident artificial selections led him to the erroneous assumption of natural selection. On the whole, however, we are not sorry that the author of the "Origin of Species" was attracted to the study of the variations of plants and animals under domestication. Had it been otherwise his greatest work embodying his greatest idea might never have been written, and biology might have had to wait for someone else to give it the enormous impulse which has followed its publication.

Many botanists will admit that Darwin did under-estimate the action of the environment, and Mr. Henslow does good service in bringing together a large number of facts in evidence of such action; but it is possible to recognise this and still to leave ample room for the action of natural selection, even though we cannot go and sit down in a field and observe nature in the act of selecting before our very eyes.

The purchaser of the volume may or may not be pleased to find that he has also acquired a classified list, occupying eighty pages, of Messrs. Kegan Paul & Co.'s publications, though one of their most important botanical works is, we notice, conspicuous by its absence.

Biblical Botany.

The Plants of the Bible. By the Rev. George Henslow, M.A., F.L.S. Fcap. 8vo. Pp. 128, with 7 plates. London: Religious Tract Society. Price 1s.

This little book forms one of the "Present Day Primers" series in course of issue by the Religious Tract Society, for the benefit of ministers, teachers of Bible-classes, and all general readers who take an intelligent interest in subjects connected with Biblical study and with religious life and work. From this point of view, Mr. Henslow's brief account of the plants referred to in Holy Writ forms a useful little volume, and should find a place in every Sunday-school library. In the introduction is a short account of the flora of Palestine and its relation to those of neighbouring countries. The eleven chapters that follow treat of textile materials, herbs, odorous gums, resins and perfumes, fruit trees, timber trees, desert trees and plants, field weeds and water plants. Wherever possible, the plant-name of Scripture is correlated with its modern equivalent, and some account of its habit and properties is introduced, while the author often improves the occasion with a few remarks of more religious tone.

British Land and Fresh-water Molluscs.

A Monograph of the Land and Fresh-water Mollusca of the British Isles. By John W. Taylor, F.L.S., etc. Parts I. and II. 8vo. Pp. 128, with 2 coloured plates, and woodcuts. Leeds: Taylor Bros., 1894–5. Price 6s. per part.

Since the appearance of Jeffreys' book in 1862 and Reeve's in 1863 no work of first-rate importance on the non-marine Mollusca of the British Islands has appeared, although Tate, Rimmer, Adams, and writers of still less conchological note have from time to time put forth small volumes intended to be more or less popular treatises on the subject. Hence the time is fully ripe for the publication of Mr. Taylor's Monograph, which has been expected for many years. As all readers of the *Journal of Conchology* know, the quondam editor of that periodical has had the subject thoroughly at heart for many a year, and has spared no pains in the endeavour to master it, his efforts being crowned with a success which is all the more noteworthy considering its study had to be pursued in the leisure moments of a busy commercial career. That the present work should show traces of this handicapping was, of course, inevitable; the wonder is that more shortcomings are not visible.

In the two parts, whose appearance has been separated by a considerable interval of time, the author cannot be said to have touched the subject in question at all as yet, for, not without wisdom, he has prefixed some considerable preliminary matter which almost amounts to an introduction to Conchology in general. Starting with a definition of the science, he proceeds to give outlines of classification and nomenclature, whence he passes to the structure of the shell, its form and variations, both normal and abnormal, in shape, size, and colour; while remarks on the operculum and clausium bring the second part to a close.

Having hinted at shortcomings, perhaps it may be as well to dispose of the more prominent of these. At the outset, it seems a pity Mr. Taylor should have gone to an obsolete encyclopædia-article

for a scheme of classification of the Mollusca, that he should have given a hopelessly out-of-date tabular view of the orders, etc., and have copied an unworkable diagram to explain the "visceral loop." The old and erroneous theory of the iridescence of nacre being due to lines of outcropping laminæ, with the popular misreading anent Brewster's button, once more makes its appearance, although a balancing sentence is inserted in part ii., where the subject is again brought forward, showing that the author evidently had his misgivings. For the system of bestowing extra or varietal names on what may be termed normal variations and on monstrosities, no word of condemnation is too strong. Again, why give to each figure of a shell the name of the collector, while the author of the anatomical diagrams is unacknowledged, whereas he at least has done something? "*Pereger*," we might hint, is considered by the best classical authorities to be a substantive and not an adjective; hence "*Limnæa peregra*" is not permissible. The nomenclature in other places is, we suspect, not above question, but that will be better seen when the systematic portion comes to hand. Many other major and innumerable minor points for criticism abound, but there is so much downright honest work to be grateful for that naught more shall be said, save to suggest that Mr. Taylor would do well to keep a closer eye on NATURAL SCIENCE if he wishes his work to be up to date.

A first cause for gratitude strikes the eye immediately on opening the book: it is the abundance of new, and, with few exceptions, excellent illustrations. They are so admirable that their frequent repetition is by no means a matter for resentment. The coloured plates, also, are far and away the best of their kind that have appeared in any English—we beg pardon—British work on the subject: their defects are those inherent in chromo-lithography. Of the text as a whole it is scarcely possible to speak till more be finished, but Mr. Taylor in those portions of his work where he is thoroughly at home expresses himself both clearly and well. Occasionally there is a repetition, as in the account of the iridescence of nacre, and in the description of the hypothesis of hyperstrophy (pp. 111, 112). This last subject is, however, very well handled and, moreover, may be quoted as evidence of how anxious the author is to do ample justice to his theme, since internal evidence shows that when the first part was written he still retained the impression that *Planorbis* was a dextral form, and changed his views later, owing, probably, to the appearance of Vanstone's paper in the *Proceedings* of the Malacological Society of London. Hyperstrophy and heterostrophy are, it may nevertheless be remarked, a little out of place under the heading "Monstrosities."

The work when complete will be one that cannot fail to be most serviceable to all varieties of conchologists, and we doubt not that the appearance of each future part will be eagerly looked forward to by all, more especially by those who, being distant from any good museum, require a well-illustrated guide such as this to aid them in their studies. B. B. W.

THE PERMIAN VERTEBRATA OF BOHEMIA.

FAUNA DER GASKOHLE UND DER KALKSTEINE DER PERM-FORMATION BÖHMENS. By Dr. Anton Fritsch. Vol. iii., pt. 4, pp. 105-132, pls. 123-132, with title-page and index to vol. iii. Prague: Fr. Rivnac, 1895.

IN reviewing the last part of Dr. Fritsch's well-known work on the Bohemian Gas-coal (NAT. SCI., vol. vi., 1895, p. 132), we referred to

the interest of the Palæozoic Palæoniscid fishes as the probable ancestors of the modern sturgeons and their allies. The new part of this work, which completes the third volume, is again devoted to these fishes as represented in the Permian rocks of Bohemia, and summarises the author's general results. The systematic descriptions are continued in the usual manner, with numerous drawings of technical points and a few restorations of species of *Amblypterus*. There are also some beautiful drawings of the ornamented head-bones of the latter genus.

The largest known Palæoniscid fish, more than a metre in length, is the gem of the collection described. It is named *Acrolepis gigas*, and exhibited in the Royal Bohemian Museum, Prague.

Among the general observations it is interesting to note that the cranial bones are proved to be thickest when least ornamented, thinnest and most irregular when the ganoine is best developed. Large otolites appear in at least one species of *Amblypterus*. There is no undoubted evidence of calcifications in the sheath of the notochord.

We are glad to add that, having now completed the consideration of the Vertebrata, Dr. Fritsch will next proceed to the description of the Invertebrata of the Bohemian Permian rocks; and there will be a supplement at the end of vol. iv. to complete the whole work.

Mens insana in Corpore insano.

The Diseases of Personality. By Th. Ribot, Professor in the Collège de France. Pp. viii., 162. Chicago: The Open Court Publishing Company, 1895.

Professor Ribot has written sensibly and with adequate knowledge and caution on a subject of great interest and difficulty. He takes his stand upon the complex unity of consciousness as correlated with the complex unity of the normal and healthy organism. He shows that by a suppression of elements or derangement of elements in this complex unity, under abnormal or morbid conditions, the personality undergoes proportional modification. He works his way onward, in a treatment which is always lucid and sometimes brilliant, from cases in which the modification is slight and superficial to cases in which it is profound and conspicuous. We welcome this book in its Englished form and express our conviction that, though much still remains unexplained, the author rightly indicates the direction in which explanation is to be sought. C. Ll. M.

Caves and their Inhabitants.

Les Cavernes et leurs habitants. By Jules Fraipont. 8vo. Pp. viii., 334, with 89 illustrations in the text. Paris: Baillière, 1896 [1895]. Price 3fr. 50c.

Professor Fraipont has added to the *Bibliothèque scientifique contemporaine* a useful little book detailing the state of our present knowledge on caves and their contents from the various points of view of geology, zoology, anthropology, history, and folklore. He devotes special chapters to the periods of *Elephas antiquus* and *Rhinoceros merckii*, the Reindeer and the Neolithic periods, and further deals with the age of metal and with historic times. An account is also given of legends and popular traditions attached to caverns. There are plenty of references to previous authorities, and this renders the book most useful to the reader; but mention should have been made of the important discoveries by Benjamin Harrison in the Plateau gravels of this country.

BIBLIOGRAPHIES.

THE bibliography of science is advancing rapidly towards more complete harmony and organisation. The Geological Survey of Belgium has long laboured in the bibliographic field of its own country. It intends shortly to publish a periodical bibliography in conformity with the decimal classification adopted by the Institut International. This work, which owes its origin to the energy of Mr. Michel Mourlon, will, as we have previously stated, be entitled *Bibliographia Geologica*. The Botanical section of the American Association for the Advancement of Science has been studying the working of the Zoological Bureau, and is likely to establish a similar bureau for botany. The International Congress of Physiology, which was held at Berne last year, adopted similar rules to those already put forward by the Association Française pour l'Avancement des Sciences, and by the International Bibliographic Congress held at Brussels. Professor Michael Foster and Dr. C. Richet, who were appointed on the bibliographic committee of the Congress, have investigated the decimal system of classification in its working at the Institut International in Brussels, and have, we understand, been favourably impressed with its applicability to all branches of science.

We have not hitherto alluded to the fact that the Department of Agriculture of the United States has for some time published a card catalogue entitled "Subject Index of Literature of Agricultural Experiment Stations and Kindred Institutions." The cards used are naturally those issued by the Library Bureau, and the classification adopted is analogous to, though not identical with, the decimal classification of Melvil Dewey. For the period from the beginning of 1888 to the middle of 1893, 9,000 slips have been published and a set is presented to every school of agriculture and every experiment station in the United States.

The Geographers, at their recent congress in London, also discussed the subject of bibliography, but left the final decision to the next congress. Meanwhile, in many countries valuable bibliographies of this subject are being published, such as the "Bibliotheca Geographica Germaniæ," by Dr. Richter of Dresden, the annual report on Austrian geography, edited by Dr. Sieger, and the "Bibliotheca Geographica Ungarica," by Dr. Rudolf Havass, which has already brought the bibliography of Hungary down to 1849, and which is to be continued by the Hungarian Geographical Society. In Switzerland, a great national bibliography is being produced by a central commission, and some 60,000 titles have already been published. In Europe, the United Kingdom shares with Spain *otium cum indignitate*. Even Brazil, Uruguay, and the Argentine Republic are engaged in bibliographing their own geographies, while the subject is being taken up in Egypt, in the United States, in Paraguay, in Australia, and in Canada. A catalogue of 3,800 writings and works relating to the geography and colonisation of the Congo has been produced by Messrs. A. J. Wauters and A. Buyl at Brussels.

The cause of decimal classification has received a temporary setback owing to the destruction of a large instalment of Professor Melvil Dewey's work, which was destroyed on its way to Europe, owing to the disablement of the s.s. "Cephalonia." We also deeply regret to hear of the serious illness of Dr. Haviland Field. Although a temporary substitute is engaged, this cannot but impair the efficiency of the Bibliographical Bureau for Zoology at the very time when it most needs Dr. Field's experience and enthusiasm.

Some Serials.

With reference to the note on *Science Gossip* that appeared in our February number, the editor has written to us as follows:—"I regret to say that from unavoidable circumstances, which I am glad to tell you were removed during the past week, *Science Gossip* has been late in publication, but we shall immediately pick up our arrears. On and after March 25 the magazine will appear as usual on the 25th of each month." We are exceedingly glad to hear that this rightly popular monthly is emerging from its retirement. The November number, which reached us after our February number was published, contains several interesting articles, among which we may mention some notes by Wilfred Mark Webb on Protective Coloration in British Clausilias, some of which resemble the bud-scales of the trees under which they live. There is also a suggestive article by J. H. Barbour, entitled "Unanswered Questions in Botany."

We have received volume v. of the third series of the *Journal of Microscopy and Natural Science*, which is the journal of the Postal Microscopical Society. Among the more interesting articles in the volume may be noticed a translation of Dr. F. Vicentini's memoir on the "Bacteria of the Sputa and Cryptogamic Flora of the Mouth." The editor states that this translation will shortly appear in book form, with a preface by Professor W. D. Miller, of Berlin, and with a bibliography and other additions by the author. The whole volume is full of interesting articles and shorter notes, and contains many original illustrations.

Volume iv. of the *Journal of Malacology* has also been received. Mr. Wilfred Mark Webb, who has been acting-editor during the past year, is to be congratulated on the success of his efforts in maintaining this useful little publication. He himself contributes to the present volume a paper on British *Testacellæ*, and some other notes. Among the contributors we notice the names of the Rev. A. H. Cooke, Charles Hedley, Walter E. Collinge, F. A. Bather, G. W. Chaster, and E. R. Sykes. The most important section of the *Journal* appears to us to be the bibliography of current malacological literature, which will in future be superintended entirely by the last-named gentleman. We understand that, owing to pressure of work, Mr. Collinge has now definitely retired from the editorship, and for similar reasons can no longer undertake to identify collections of slugs.

Literature Received.

Deep and Shallow-Water Fauna of the Kerguelen Region, John Murray: (*Trans. Roy. Soc. Edin.*). Catalogue of Fishes, G. A. Boulenger; Catalogue of Mesozoic Plants, A. C. Seward; Catalogue of Fossil Birds, A. S. Woodward: British Museum (Nat. Hist.). Evolution and Man's Place in Nature, Henry Calderwood: Macmillan. Grundriss der Krystallographie, G. Linck; Ueber Germinal Selection, A. Weismann: Fischer, Jena. By Tangled Paths, H. M. Briggs: Warne.

Entwurf einer Gliederung der pelagischen Sedimente des Trias-systems, E. Mojsisovics, W. Waagen, and C. Diener. Étude sur Mammifères, R. F. Scharff: Soc. Zool. France. Flora of Nebraska, pt. xxi., Rosales, P. A. Rydberg: Neb. Dept. Bot. Vanua Lava, J. J. Rendle: *Rep. Geol. Soc. Australia*. Notes on Georgina Basin, R. L. Jack: *Proc. R. Soc. Queensland*. British Geology, T. M. Reade: *Geol. Mag.* On Probable Origin of N.A. Species of Diabrotica, F. M. Webster: *Journ. N.Y. Ent. Soc.* History of Mankind, F. Ratzel, pt. v.: Macmillan. Royal Natural History, pt. xxviii.: Warne. Report on Injurious Insects, 1895, Ormerod: Simpkin.

Knowledge, Feb. Review of Reviews, Feb. Nature, Jan. 16, 23, 30, Feb. 6, 13. Literary Digest, Jan. 11, 18, 25, Feb. 1, 8. Revue Scientifique, Jan. 18, 25, Feb. 1, 8, 15. Irish Naturalist, Feb. Revue Générale des Sciences, Jan. 15, 30. Feuille des jeunes Naturalistes, Feb. Naturen, Jan. Nature Notes, Jan., Feb. American Journ. Science, Feb. Naturæ Novitates, Jan. (1 & 2). American Geologist, Feb. American Naturalist, Feb. Victorian Naturalist, Nov. Science, Jan. 31. Scottish Geographical Magazine, Feb. Science Gossip, Nov., Dec. The Naturalist, Feb. Westminster Review, Feb. Botanical Gazette, Jan. Biology Notes, Jan. The Photogram, Feb., and special no. Bull. Inst. Internat. Bibliographie, 2 & 3. Princeton Contrib. Psychology, vol. i., no. 3.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments have recently been made:—M. D. Hill, to succeed W. L. Sclater as curator of the Museum and Lecturer in natural science at Eton College; Dr. Otto Mügge, to be Professor of Mineralogy at Königsberg; Dr. A. Weiss, to be Assistant in the Mineralogical Institute of Greifswald University; Professor Theodore von der Goltz, to be Professor of Agriculture at Bonn University; Dr. K. Fritsch, to be Extraordinary Professor of Systematic Botany in Vienna University; Dr. K. Mikosch, to be Professor of Botany at the Brünner Polytechnikum; Felix Bassler, as Assistant in the Agricultural Institute at Leitmeritz; Dr. G. Horváth, of Budapesth, to be Director of the Zoological Department of the National Museum in that city; Dr. R. de Girard, Privat-docent in Geology at the Zürich Polytechnikum, to be Extraordinary Professor; Dr. F. Saccardo, to be Professor of Plant-pathology at the School for Viticulture in Avellino; Dr. W. J. Nickerson, of Colorado University, to be Instructor in Biology at the University of Evanston, Ill.; Charles D. Aldright, to the similar post at the University of Cincinnati; Dr. W. A. Setchell, of Yale College, to be Professor of Botany in California University; Dr. C. A. Strong, to be Lecturer on Psychology in Columbia College, N.Y.; Dr. W. S. Strong, to be Professor of Geology in Bates College, Lewiston, Maine; W. J. Blake, to be Professor of Geology and Mining at Arizona University; T. C. Hopkins, to be Assistant Professor of Geology in the Pennsylvania State College; Thomas A. Jaggar, to be Instructor in Geology, and Dr. Chas. Palache, to be Assistant in Mineralogy, at Harvard University; Dr. F. Katzer, formerly Assistant in the Mining Academy, Leoben, to be Director of the Geological Department of the Para Museum. Dr. Knuth, of the Kiel Ober-Realschule, has been raised to the dignity of Professor.

THIS year Lord Kelvin will celebrate his jubilee as Professor of Natural History in the University of Glasgow. The authorities of the University and the Municipality of the City intend to recognise this in some adequate manner.

THE Anthropological Institute of Great Britain has elected Dr. Hjalmar Stolpe, of Stockholm, an honorary member. Dr. Stolpe is well known for his ethnographical and archæological researches, and especially for his investigations on the evolution of savage art.

THE *American Geologist* announces that Professor James Hall has had several gold medals struck to commemorate the services of some of the men who have enabled him to carry on his official work in the State of New York. Among these are Jacob A. Cantor, James W. Husted, Daniel P. Wood, and Danforth E. Ainsworth: legislators whose friendship for science might otherwise have passed unrecognised.

THE Director of the British Museum (Natural History) has written a special letter to Mrs. Henry Seebohm, conveying to her the thanks of the Trustees for the bequest of the late Mr. Seebohm's ornithological collection, and their high appreciation of his labours in the cause of that science. "The collection," says the letter, "is found to contain about 16,950 specimens, including 235 skeletons, and in extent

and scientific value it is one of the most important that the British Museum has ever received. The fact that many of the specimens are types, and form the material upon which much of Mr. Seebohm's ornithological investigations and work are founded, must greatly enhance the interest and value of the bequest. Besides the types in the collection, and a large series from localities hitherto unrepresented in the museum, there are many specimens with historical associations attached to them, such as Swinhoe's Chinese birds; Pryer's Japanese birds; Anderson's Indian birds; a nearly perfect set of the birds of Mount Kina Balu; and the invaluable series obtained by Mr. Seebohm himself in the Petchora and Yen-e-sai Valleys."

THE evening lectures at the Whitechapel Museum have been meeting with considerable success. Professors Michael Foster and Victor Horsley were the lecturers for January and February. On March 10 Mr. A. Smith Woodward will lecture, at 8 p.m., on the Savages of Ancient Britain. Admission is free, by ticket to be obtained in the museum or lending library.

THE Chadwick Museum at Bolton has recently had its collection of butterflies and moths considerably enriched through the generosity of Mr. J. P. Thomasson of that town. The Museum now has a nearly complete set of British birds, and we are glad to say that the specimens are not confined to skins, but that each family is represented by an articulated skeleton. Some progress has also been made in this direction with the higher vertebrates. We are not surprised to learn that, in the words of the curator, W. W. Midgley, "these exhibits are creating a new interest to many visitors, while to the student they are especially helpful." Numerous visits by the children of elementary schools have taken place under the recent alteration in the Education Code, and the results obtained are, in the curator's opinion, very satisfactory.

WE have already published a description, from the pen of Dr. Henry Woodward, of the way in which Norwich Castle has been transformed into a museum. An excellent little guide, compiled by Mr. Thomas Southwell, has just been published at the low price of 6d. by Messrs. Jarrold & Sons, and gives almost as much for the money as do the well-known guides of the British Museum. The greater part of it is devoted to the collection of birds, in which, especially in foreign raptorial birds, the museum is very rich. Most of these were presented by the late J. H. Gurney. The son of the latter, Mr. J. H. Gurney, of Keswick Hall, Norwich, is desirous of completing this collection, and has sent us a couple of printed fly-leaves containing the names of desiderata. He will no doubt send such lists to any who may have birds to sell. Among the novelties mentioned in the guide we note the collection of local antiquities, presented, just before his death in 1895, by Mr. R. Fitch. These are now exhibited in a small room specially constructed and fitted up for the purpose, and contain many remains from the Stone age, as well as from later periods, some of which are here figured.

The Curator, Mr. J. Reeve, informs us that the museum has been opened on Sunday afternoons since April last, and that the experiment has proved so successful that the council have decided to continue it. A pleasing feature of the success is that it has been a steadily growing one. Even during this year the number of visitors has gradually increased, from 1,126 on January 5 to 1,491 on February 9.

ON March 10 the Honourable W. B. Massey Mainwaring, seconded by Mr. Thomas Lough, will move in the House of Commons: "That in the opinion of this House it is desirable that the national museums and art galleries in London should be open for a limited number of hours on Sunday after two p.m., upon condition that no officer shall be required to attend upon more than six days per week, and that any who may have conscientious objections shall be exempt from Sunday duty."

ON March 3 a discussion on Zoological Nomenclature will be introduced at the Zoological Society in a paper by Dr. P. L. Sclater, entitled "Remarks on the Divergences between the 'Rules for Naming Animals' of the German

Zoological Society and the Stricklandian Code of Nomenclature." No doubt the reason why the rules of the German Zoological Society are specially mentioned rather than the rules formulated by the International Congress of Zoologists, is that the German Society, as we announced some time ago, is preparing a synopsis of all living animals, under the editorship of Professor Schultze.

A SPECIAL interest attached to the Linnean Society's meeting on February 6, when Sir William Flower presented, on behalf of the subscribers, a portrait of Mr. William Carruthers. In making the presentation, Sir William referred to three aspects of Mr. Carruthers' work—as a botanist, as a curator of the great national collection of plants at South Kensington, and as an active worker in the interests of the Society, especially during his term of office as president. His presidency included an important year in the Society's history, namely its centenary; and in the successful carrying out of the formalities and festivities connected therewith, Mr. Carruthers displayed his characteristic ability for organisation and capacity for saying the right thing in the right place. As evidence of the keen interest which he took in the Society, reference was made to the perseverance with which he had got together all possible information on the various portraits of Linnæus, visiting Sweden and Holland for the purpose. In accepting the portrait, on behalf of the Society, the president, Mr. C. B. Clarke, mentioned Mr. Carruthers' work in palæobotany and his services to agriculture.

A CONGRESS of delegates from the Natural History Societies in the three S.E. counties of England is convened by the Tunbridge Wells Natural History Society for Saturday, April 25, and will be held at Tunbridge Wells under the presidency of the Rev. T. R. R. Stebbing. The subjects for discussion are:—(1) A scheme for the circulation of lantern slides illustrating natural history subjects among the affiliated societies during the winter session. This is already in operation, and fifty slides are being exhibited in different towns; (2) the interchange of lantern and microscope slides, books, and magazines with affiliated societies and with similar associations in other districts of the United Kingdom; (3) the re-delivery of lectures before other societies; (4) the protection of footpaths, commons, etc.; (5) summer excursions and field-work; (6) the best kind of programme for the winter session. The congress will also discuss the rules and date and place of meeting of future congresses, should such be determined on. Others than delegates from societies are invited, though they will not be entitled to vote. Cards of invitation may be obtained from Mr. George Abbott, 57, The Pantiles, Tunbridge Wells.

THE French Association for the Advancement of Science will meet at Tunis from April 1 to 4. Further information may be obtained from the secretary, 28 rue Serpente, Paris.

THE various American Scientific Societies had their annual meetings at the close of last year. Lists of the papers read are published in the February number of the *American Naturalist*.

IN view of the attempts that have recently been made to legalise the use of the metric system in Great Britain, it is interesting to notice that it has been introduced into the new edition of the British Pharmacopœia.

WE regretted to hear a short time ago that a male and female of the Golden Eagle had been shot in Kent, and had passed into the hands of the local taxidermist. A correspondent of *Science Gossip* states that this was only "an immature white-tailed or sea eagle." *A propos* of this, Mr. H. S. Salt draws attention to the following suggestions offered by the Humanitarian League as to the best use which county councils can make of the powers given them by the Wild Birds Protection Act of 1894:—

(1) That all protection which mentions particular species of birds is unsatisfactory, because some species are almost sure to be omitted, which, not being common,

do not attract attention, and thus no protection is given to strangers or casual visitors, whom it is highly desirable to protect.

(2) That all birds without exception are of some use in the economy of Nature, and though certain classes may desire the destruction of some birds who interfere with their immediate interests, this destruction will probably result in loss to the community as a whole.

(3) That if all cannot be protected, the right principle is to make the law general in its terms, and enumerate just those species which are to be outside the pale of protection, not those which are to be within it.

The Home Secretary has ordered that :—"(1) The Wild Birds Protection Act, 1880, shall apply within the administrative county of the parts of Kesteven, Lincolnshire, to the following wild birds, viz. :—Kestrel, merlin, hobby, common buzzard, honey buzzard, swallow, house martin, sand martin, swift, and wryneck, as if those species were included in the schedule to the Act. (2) The taking or destroying of the eggs of the following wild birds is prohibited within the administrative county of the parts of Kesteven, Lincolnshire, viz. :—Goldfinch, kingfisher, nightjar, nightingale, owls (of all species), ruff or reeve, woodpecker, kestrel, merlin, hobby, common buzzard, honey buzzard, swallow, house martin, sand martin, swift, wryneck, teal, and wild ducks (of all species)."

An expedition of sixteen men, headed by Dr. Cook, has started in two small vessels of 100 tons each for the bay of Erebus and Terror. Six of the men are students of science.

The *Scottish Geographical Magazine* for February has a note on the new "Bell" River, more than 500 miles long, discovered last year by Dr. Robert Bell of the Canadian Geological Survey. The drainage-area of the new river is considerably larger than the whole of England. The country is gently undulating with an elevation of 1,000 feet along the watershed, diminishing to 400 feet at 100 miles from the mouth of the river, and then falling rapidly to James Bay. It is covered with forests, the soil is fertile, and the climate fairly good.

Through the courtesy of Mr. C. E. Fagan, we are enabled to state that the naturalists, Messrs. Austen and Cambridge, on the Siemens telegraph expedition to the Amazon have already begun successful operations, the fact that the "Faraday" was stuck for a whole week on a mud-bank at the west end of Parana de Buyassu in no wise interfering with the aims of the collectors. The chief find at present has been two specimens of *Peripatus*, belonging apparently to different species. The naturalists decided to stay at Santarem, while the "Faraday" proceeded to Manaos, which place it reached on February 8, all well.

Professor H. de Lacaze Duthiers informs us that, as in former years, he will conduct an excursion at Banyuls during the Easter vacation, that is, from March 28 to April 11. Those joining the party can obtain return tickets from Paris to Banyuls for 46 francs. Among those who will attend are Professors Von Graff, of Graz, Pruvot, of Grenoble, and Yung, of Geneva, and probably some naturalists from Barcelona. The Professor desires to extend through us a cordial invitation to any English naturalists.

On February 13 a telegram from Irkutsk was received in St. Petersburg, stating that Mr. Kuchnareff, a Siberian trader who acted as agent for Dr. Nansen, had received intelligence that Dr. Nansen had reached the North Pole, where he had found land, and that he was on his way back. The opinions of experts are divided as to the truth of this, and, up to the moment of going to press, no confirmation had been received.

The hydrographical exploration of the Skagerack has just been begun under the auspices of the Swedish Government and the direction of Professor O. Pettersson.

A proposal to prohibit vivisection in Zürich has, says the *Revue Scientifique*, been rejected by 39,476 votes against 17,297. On the other hand, a motion of the Grand Council to protect animals, except such as are required for scientific purposes, has been accepted by 35,191 votes against 19,551.

CORRESPONDENCE.

Foraminifera of the Chalk and of To-day.

After careful perusal of the criticism of my paper on Oceanic Deposits Ancient and Modern (Natural Science, vol. vii.; Oct., 1895), by Messrs. Burrows and Holland, I am forced to the conclusion that they have failed to grasp both the spirit and the substance of the hypothesis I had intended to suggest, and your insertion of these remarks may perhaps be of service in more clearly defining its scope and aim.

My object was partly to answer a very valid objection raised by Mr. Philip Lake (*Science Progress*, Feb., 1894) to a certain point in my paper on the "Genesis of the Chalk," and my study of the subject led me to the conclusion that the *association* of a number of forms in the lower beds of the Upper Cretaceous, and also the association of apparently identical forms in certain areas at the present day, notably at Culebra Island, could scarcely be accounted for except on the assumption that in both cases similar conditions had existed. On p. 271, par. 3, I endeavoured to show that this connection was a very close one, and cited, in support of this statement, the presence of various species, ten in all, including the Textularias and Verneuilinas; the fact of these forms being found separately in other areas, a fact of which I am perfectly aware, does not, to my mind, invalidate the interest of their occurrence *all together* only in certain limited positions.

The authors remark: "*T. trochus* is plentiful in the waters of many tropical and sub-tropical areas, and is by no means confined to localities having the peculiar position assigned by Mr. Hume to Culebra Island." If these gentlemen will turn to a work published by me in 1893 (Chemical and Micro-Mineralogical Researches, etc.), they will find on p. 17 that I remarked, respecting this actual form: "At the present day it is common off our own shores, but, though cosmopolitan, it is more generally restricted to tropical and sub-tropical areas." It will therefore be evident that it was association, and not individual distribution, to which I more specially desired to draw attention, and upon which, in fact, I based my argument. My reasons for confining my remarks specially to the arenaceous Foraminifera are: (1.) That these were the only ones I could obtain from the method adopted in the examination of the residues from Cretaceous beds. (2.) Because, from the fact of their being arenaceous, they would be the most likely to be affected by the presence of coast lines; and (3.) Because in all probability they are mainly, if not entirely, non-pelagic.

Seeing that I had no evidence to prove their existence during Cretaceous times, I excluded from the scope of my observations such irregular arenaceous types as *Rhizammina* and *Hyperammina*, which have a deep-sea extension of an altogether remarkable character; the hyaline and porcellanous forms, also, were not introduced as *association forms*, many of them being pelagic, and consequently independent of coast-line influences or of current-borne material, besides which their general zonal distribution during the Cretaceous period is as yet undetermined.

I think my critics will pardon me if I point out that it is scarcely fair criticism to detach lines from sentences, and remark upon them, without any statement whatever that they (together with the context, and only in such connection) form part of a general train of argument.

They thus make a quotation from p. 273 of my paper: "At the present day the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms," but make no allusion whatever to the fact that in that very paragraph I closely connect the existence of the majority of Arenacea with the areas of terrigenous deposits, a point which, I maintain, is of the greatest importance. In their paper they have selected the type of *Haplophragmium* as a proof of the deep-sea extension of Arenacea, but entirely ignore that, on page 274, I have made special mention of two species of this same type as extending into greater depths.

Before writing the paper I made a minute examination of the "Challenger" reports

noting the stations in their bathymetrical order, with the Foraminifera found at them, and to my mind the conclusion is irresistible that the vast majority of the arenaceous species and genera do not normally occur at depths beyond 400 or at most 500 fathoms; indeed it is a notable fact that, of the four examples quoted by my critics from Australia and Ceylon, not a single one is outside the limits of terrigenous deposits. When they inform us that 70 miles from Raine Island the arenaceous species are ten in number at 790, and twenty at 985 fathoms, they quite forget to mention that at Raine Island itself, at 155 fathoms, there are thirteen genera and forty-six species, *Textularia* alone having over ten species to itself! As regards those cited from off the Coast of Africa, under the letters *c*, *d*, and *e*, it is impossible to include these in this discussion, seeing that the authors give no details whatever of the character and species of the Arenacea they state to have been obtained there.

The reason why the coarse Arenacea should occur within this limit is evident; their tests being made up of fine sandy materials, they will, for the most part, be found where that material is most abundant, viz., within the area of the mud-zone. Seeing, therefore, that oceanic slopes are usually very gradual, it is only, as a rule, at a distance of about 200 miles from the coast that a 500-fathom limit would be reached; should, however, the slope be sudden, and the arenaceous material plentiful, they will in that case, as the writers observe, be found at any depth; but this, it must be observed, must always be within the range of materials indispensable for building up their shells.

If my critics will carefully reconsider the quotations taken from my article on pp. 273 and 274, they will probably admit that on two particular points they have misinterpreted my meaning. In the one case they appear to infer that under the term "coarse arenaceous Foraminifera" I include "all arenaceous Foraminifera"; and in the second case, quoting from p. 274, "Those species which are restricted to the Chalk Marl, etc., are those which occur to-day at depths of less than 400 fathoms," they seem erroneously to have taken the word "occur" to be intended by me as synonymous with "are restricted to."

These points, I think, are of special importance in their argument, for, acting under these assumptions, they proceed to deal with eleven species from different parts of my paper, all of which they erroneously commit me to have restricted to a depth of 400 fathoms, and having thus proved to their own satisfaction that all my premisses are wrong, they virtually assume that my suggested hypothesis is baseless.

Had Messrs. Burrows and Holland clearly understood my paper, it could scarcely have escaped their notice that, on p. 274, referring to four of the species, viz., *Textularia agglutinans*, *Gaudryina pupoides*, *Haplophragmium latidorsatum*, and *Ammodiscus incertus*, I cite them as being particularly capable of deep-sea extension—and why did I particularise this point? Certainly, it was with no intention whatever of demonstrating that my previous statements regarding distribution were erroneous, but with the special object of showing that those forms which are capable to-day of existing beyond the 500-fathom limit, and, as our anthors say, may go to any depth, *are precisely those and only those* which I have found to pass into zones of the Chalk *higher than those* of the Lower Grey Chalk, and I therefore consider them as strong evidence in favour of my hypothesis.

Again, it is evident that, when in my paper I specially mention Culebra and Raine Islands, I am referring to a geographical area which must equally embrace all other localities possessing the same climatic and other conditions within that area, therefore including New Guinea, Torres Straits, and the Arafura Sea. Of the four species noted by me, *Tritaxia tricarinata*, *Spiroplecta annectens*, *Gaudryina rugosa*, and *Frondicularia archiaciana*, as occurring all together at Raine Island, the first is known only there, the second occurs almost exclusively within that geographical area, the third (as Mr. Chapman reminds me) is stated by Brady to have its finest development at Raine Island, and the fourth has hitherto been discovered in no other place, and I must re-emphasise my opinion that the association of these forms, which are all typical Cretaceous ones, within a certain geographical area at the present day is extremely suggestive to the student of physical conditions during

the Chalk period. The fact that *Spiroplecta annectens* has been found at greater depths is not in any way surprising, for, far from being a coarse-grained type, it is one of the most delicate of all the Arenacea.

One word upon their closing remarks, vol. viii., p. 104. "In reference to the question of the depth at which the Taplow Chalk was probably laid down, Mr. Hume places great stress upon the occurrence together at Culebra Island of *Verneuilina pygmæa, et seq.*" This statement is liable to mislead, seeing that I made no reference whatever as to the depth at which the Taplow Chalk was deposited. I only mentioned these species in association with others as additional evidence of the importance of Culebra Island from a Cretaceous point of view, and, as a matter of fact, there are at least thirty-two forms in actual existence there capable of being directly compared with Cretaceous types; but I expressly left them out of the discussion, seeing that a number of them might be considered as pelagic.

In studying the Foraminifera, I think it may be advisable to lay stress upon the fact that, in the present state of our knowledge of their animal structure, it is impossible to attach particular importance to "genera" and "species." These terms have been employed by me, as by all those who are interested in these fascinating little tests, to indicate forms, often of most beautiful and definite construction, but, nevertheless, throwing but little light on the nature of the organisms that constructed them. It is a presumption, and a fair one, that similar results have been produced under similar conditions; it is also admissible to assume that the animals constructing them at the present day are similar to, if not identical with, their prototypes of the Cretaceous period.

I have desired in my paper to refrain entirely from anything approaching dogmatism. My research has been merely carried out on these lines in the hope that some light may be thrown on a path which, at present, is very obscure. This, so far as it has gone, tends to show that, whatever the conditions may be now, they were, in Cretaceous times, running on parallel lines to those existing in certain areas at the present day, and my aim will have been attained if my researches should lead others to consider, without prejudice or factiousness, the problems underlying the ancient and modern faunal distribution.

W. F. HUME.

WITH reference to the foregoing remarks of Dr. Hume upon our criticism of the evidence from the Foraminifera adduced by him in his paper on "Oceanic Deposits Ancient and Modern," we have to say:—

1. As we were careful to explain, we refrained altogether from discussing the main hypothesis propounded by Dr. Hume. We simply ventured to question the evidence as to the distribution of certain Foraminifera in recent seas which the writer brought forward in support of his argument.

2. Dr. Hume objects that, in quoting from his paper the passage—"at the present day the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms"—without giving the context, we have been unfair to him. We have again read over his paper, and we cannot see that it contains anything to show that the words we quoted were not intended to be taken as the expression of a general law. We find nothing to imply that *at the present day* the coarse Arenacea are to be met with, at all commonly, at depths beyond 400 fathoms. Now, doubtless, Dr. Hume has modified, to some extent, his former statement; but, if so unnecessary to the argument, why was a 400-fathom limit mentioned at all? In point of fact, however, anyone reading together Dr. Hume's papers on "The Genesis of the Chalk" and "Oceanic Deposits Ancient and Modern" must see that considerable importance was attached to this limit of 400 fathoms.

3. We were quite alive to the fact that Dr. Hume laid stress upon the *association* of certain forms—notably three species of *Textilaria* and three species of *Verneuilina*; and we put forward considerations tending, as we think, to show that such weight as the writer attached to this association could not properly be conceded. We cannot see that his further remarks make the argument from the association of so small a number of such protean forms as the Foraminifera any stronger. The associated forms occur as independent individuals; they do not make up a kind of zoological compound; and when it is shown—to take the three

Textilaria for example, that one of the species is found in all seas and at all depths, that the remaining two forms are very closely allied, if not the same, and that the more robust of the two is to be found commonly in localities having a far different character to that of the locality specially selected, we cannot see that such association can furnish evidence of much value.

4. Dr. Hume passes over the evidence adduced by us from our Indian Ocean soundings, notwithstanding that they are admittedly derived from a non-terrigenous deposit, because we did not give the actual list of species obtained. We omitted the list simply for the sake of brevity. It is as follows:—*Saccammina sphærica, Hyperammina elongata, H. subnodosa, H. vagans, H. ramosa, Rhabdammina abyssorum, Rheophax pilulifera, R. dentaliniformis, R. nodulosa, R. guttifera, R. spiculifera, R. distans, Haplophragmium agglutinans, H. emaciatum, H. rotulatum, H. latidorsatum, H. glomeratum, H. globigeriniforme, Ammodiscus tenuis, A. gordialis, A. charoides, Trochammina trullissata, T. ringens, Textilaria quadrilatera, T. agglutinans, T. agglutinans* var. *augusta, T. agglutinans* var. *porrecta, Verneuilina pygmæa, V. polystropha, V. propinqua, Gaudryina pupoides, G. siphonella, Clavulina communis.* Many of them, it will be seen, are coarse forms, and though Mr. Hume would like to leave some of the genera and species out of consideration, notwithstanding their coarseness, we do not see that he is entitled to do so.

5. We are accused of understanding the word "occur" in the sentence—"Those species which are restricted to the Chalk Marl and Lower Grey Chalk are those that occur to-day at depths of less than 400 fathoms"—as being synonymous with the phrase "are restricted to." We did not so understand it; but we did assume that it bore more than the merest literal signification. Surely the argument which the evidence was brought forward to support requires that the species cited should be particularly characteristic, at the present day, of depths not exceeding 400 fathoms. Moreover, if the word "occur" in the passage quoted is to bear a literal signification only, what is the force of the following parallel statement from the author's paper on the Genesis of the Chalk (p. 226): "It is of importance to note, then, that the Foraminifera which predominate in the lower zones of the Lower Chalk are those which *do not pass beyond the 400-fathom line*"? We are further accused of taking the species dealt with by us in detail "from various parts of the paper." It cannot be contended that we have wrongly brought them together as constituting the evidence in support of the argument; and that being so, we can only say that for their distribution over the paper we were not responsible.

6. Dr. Hume objects that, when referring to the number of arenaceous species found in the soundings seventy miles from Raine Island at depths of 790 and 985 fathoms respectively, we "quite forgot to mention that at Raine Island itself at 155 fathoms there are thirteen genera and forty-six species." We were not unmindful of the fact; but we were anxious to compare only things comparable. Our own material from the two soundings above-mentioned consists in each case of the contents of the sounding-tube at one haul. The *quantity* of material is the same. The "Challenger," off Raine Island, took "soundings and dredgings," and doubtless obtained a great quantity of material. Had we had as much material from the deeper soundings we referred to, we should doubtless have found a much larger number of "genera" and "species."

In conclusion, we should like to state again that we have made no attempt to disprove the main hypothesis that Dr. Hume has brought forward. It is quite possible that it may prove perfectly sound. It seemed to us, and it seems so still, that the evidence adduced from the distribution of recent Foraminifera had in it many weak points.

H. W. Burrows.
R. Holland.

Peripatus in the "Cambridge Natural History."

I am glad to have the opportunity, which your review on the last volume of the "Cambridge Natural History" has given me, to refer to the attempt made by Mr. Pocock to break up the genus *Peripatus* and to establish three genera in its place. Your reviewer reproaches me with having taken no notice of this suggestion, which

was made, as he correctly states, in 1894. May I inform your reviewer that the very same suggestion was made to me in 1886, nearly ten years ago, by a distinguished zoologist, who adduced all Mr. Pocock's reasons, together with one not mentioned by Mr. Pocock? I considered that suggestion at the time, *i.e.*, when I was preparing my monograph, and had all the facts before me, and rejected it as bringing no benefit, and only adding unnecessarily to the nomenclature of the group. I read Mr. Pocock's paper when it came out, and so far from finding that he added to our knowledge of the genus, it appeared to me that his own knowledge of the facts already established was not up-to-date in at least one important particular. I was not, therefore, inclined to attach much weight to his remarks; at any rate they did not appear to me to have that importance which would justify reference to them in a work of the scope of the "Natural History."

As to the other point referred to by your reviewer, I may say, in justice to my editors, that the "Cambridge Natural History" is not a monograph, and is not intended to give a complete list of species or even of genera. My synopsis was reprinted to give an idea in a small compass of the principal forms and localities of the genus. I might, of course, have left out all but the best known forms, but I wanted to create an interest in the genus in the various places in which it is found. It was, as your reviewer points out, misleading on my part to call this list a synopsis, and I greatly regret having allowed such an oversight to pass. At the same time, may I call attention to the fact that some new points have been tentatively put forward in the "Natural History," in the so-called synopsis, which were not in my monograph? These points, it is true, require confirmation by extended observations, but if established they will have considerable interest and some importance. It is odd that they should have escaped the notice of a critic of the minuteness of your reviewer.—Yours faithfully,

Zoological Laboratory, ADAM SEDGWICK.
New Museums, Cambridge.
February 10, 1896.

MY best thanks are due to Mr. Sedgwick for his courtesy in pointing out the error of my statement, that his "synopsis" in the "Cambridge Natural History" had been *exactly* reprinted from the monograph of 1888. There are indeed a few additions, which I must confess I overlooked; for I naturally thought that Mr. Sedgwick would have corrected his list before he added to it. It is of interest to know that a "distinguished zoologist" privately suggested the division of *Peripatus* into three genera ten years ago. It is the more remarkable that, with this fact in his memory, Mr. Sedgwick should have deliberately omitted all reference to the published conclusions of Mr. Pocock, who has done so much good systematic work on the animals most nearly related to *Peripatus*. Mr. Sedgwick's reasons for disagreeing with two naturalists of some eminence would be of general interest.

Science and Art Museum, GEO. H. CARPENTER.
Dublin.

[The additions of "interest and importance" to Mr. Sedgwick's Synopsis are: the erection of variability of colour into a character of the genera that he diagnoses but refuses to accept; two statements concerning constancy in number of legs, which statements are mutually contradictory; a reference to Miss Pollard's paper, while still ignoring the name she proposed; two notes of interrogation, and a mis-spelling.

[Letters from Mr. Conway Macmillan, Mr. P. S. Buckman and Mr. T. T. Groom are unavoidably held over.—Ed. NAT. SCI.]